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ABSTRACT

Prepared for use in the 5th grade, this teacher's handbook consists of 19 science units dealing with environmental education. Topics are ecology, language arts, rocks and fossils, soil, noise pollution, Nashville pioneers and American Indians, conservation, waste and litter, water pollution, compass and mapping, plants and trees, use of the senses, animal homes, air pollution, arts and crafts, insects, mathematics outdoors, plot study, the total environment of an area, and energy. Unit objectives, time length, concepts, vocabulary, activities, and a list of resource materials are given for each. (NQ)

ED 099 912

Teacher's Handbook Grade 5

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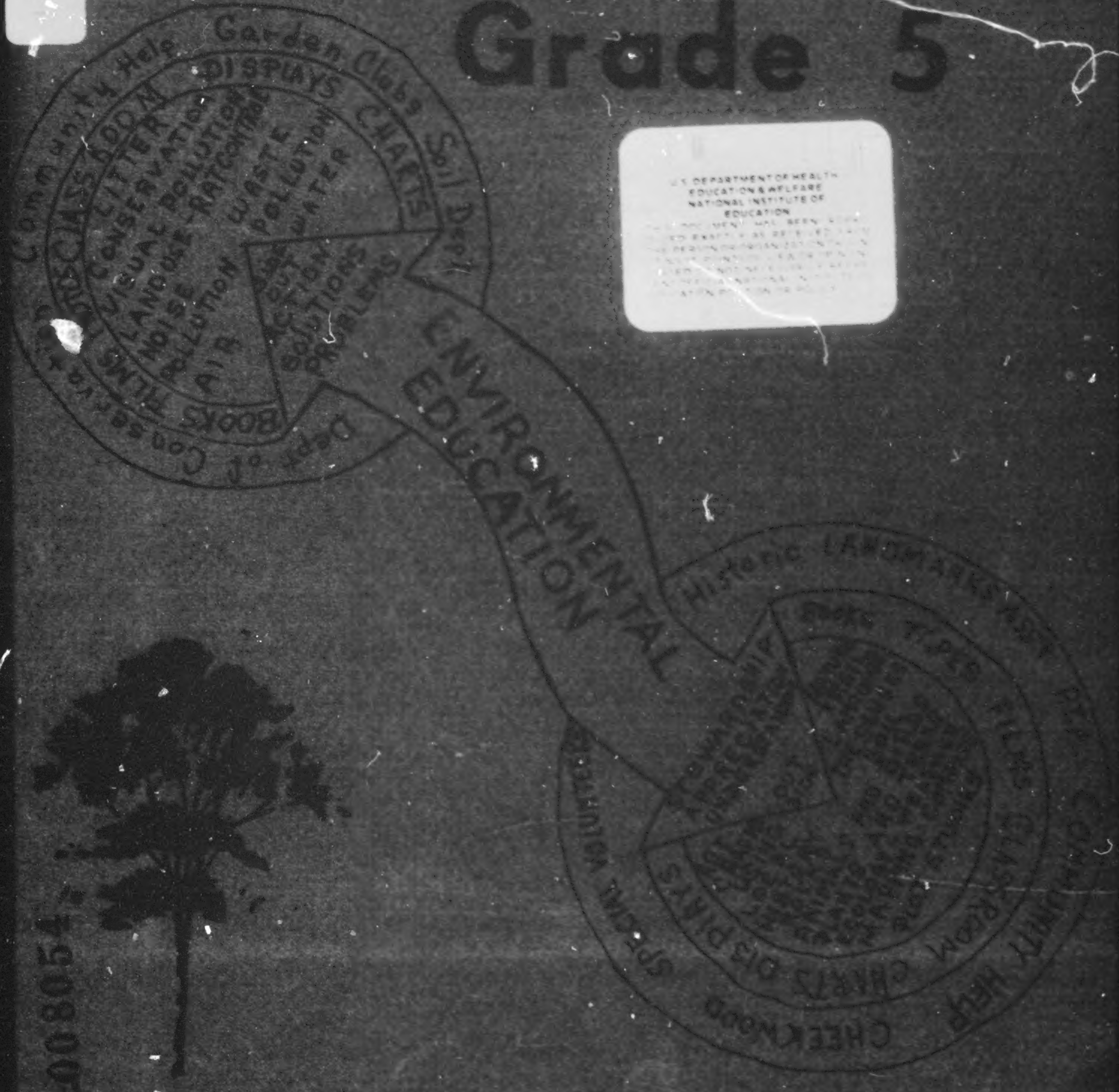
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ECOLOGY APPROACH

I. Concepts to be developed

1. Man shares the earth with many other living organisms.
2. All are dependent on each other and the physical environment.
3. Earth resources are finite and have been able to maintain life over millions of years, only because they are cycled and recycled.
4. The time has come for people to make the choice to preserve and protect the earth and its inhabitants, or to ignore danger signals and perhaps make earth uninhabitable for all living things, including man.

II. Brief discussion of Ecology [Environment] and why it is important how man is dependent on his environment for his continued survival. His environment consists of:

1. Air
2. Water
3. Soil
4. Plants
5. Animals
6. Natural Resources

III. Procedure at school site--Discussion in class--Discussion on school grounds with children actively involved in various activities.

1. Soil Conservation
    - A. Erosion
    - B. Formation
    - C. Importance
        1. grasses
        2. perculation test if possible
    - D. What is soil?
    - E. Is every person either directly or indirectly dependent on the soil?
    - F. What problems does an increasing population place on man and his use of the soil?
    - G. Earthworms and their importance to the soil.
    - H. Soil testing.
2. Micro-communities--within this large school community there exists various smaller communities dependent on the total community.
    - A. Micro-community of a tree.
    - B. Producers and decomposers.
3. School Building and Grounds
    - A. Work sheet.
    - B. The importance of beautifying the school community.
4. Life Cycles
    - A. CO2/O2 Cycle.
    - B. Energy [food chains] cycle.
    - C. H2O Cycle.
5. How man depends on the total environment for his survival--food--water--shelter. How this environment depends on man's care and desire to control the following:
    1. Air
    2. Water

3. Noise
4. Population
5. Waste Disposal

FILMS:

CHAIN OF LIFE	Sc.--456
ENVIRONMENTAL AWARENESS	Sc.--602
FOOD CHAINS IN THE OCEAN	Sc.--628
FOOD CYCLE AND FOOD CHAINS	Sc.--345
FOOD GETTING AMONG ANIMALS	Sc.--45
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LIFE IN THE FOREST	Sc.--488
LIVING THINGS ARE EVERYWHERE	Sc.--357 & 626
MAN'S EFFECT ON THE ENVIRONMENT	Sc.--621
NATURE'S HALF ACRE	Sc.--582
PARTNERSHIPS AMONG PLANTS & ANIMALS	Sc.--324
ECONOMIC GEOGRAPHY: THREE FAMILIES IN DIFFERENT ENVIRONMENTS	Sc.--745

ECOLOGY--80-90 minutes or two 40-minute sessions

Concepts:

I. Man shares the earth with many other living organisms.

II. All are dependent on each other and physical environment.

III. Earth's resources are finite and have been able to maintain life over millions of years, only because they are cycled and recycled.

IV. The time has come for people to make the choice to protect the earth and its inhabitants, or to ignore danger signals and perhaps make earth uninhabitable for all living things, including man.

Objectives:

I. To help the student become aware of his environment.

II. To help students see the interrelationships of living organisms and their physical environment.

III. To show that there is a balance in nature and when altered, through some interference, might result in harmful changes.

IV. To develop a love for his natural community.

V. To develop an Ecological Ethic.

Vocabulary:

ecology
consumers
interrelationship
succession
scavengers
adaptation
community [man-made and natural]

dependent
food chain
decomposers
balance
life cycles
carnivores

habitat
change

pollution
environment
predators

1. Help children form a definition of Ecology through discussion.

a. Ecology - comes from two Greek words that mean "study of the home". Whose home? Yours? A rabbit's? A turtles?

b. Lead children to discover that Ecology deals with the "how, why and where plants and animals live - [community].

c. Basic definition - study of living things in their habitats, and what is happening there.

1. Make sure the students know and understand the word habitat and community.

2. Having established a definition "study of living things", lead children in discovering what is essential for living things.

a. The sun - source of all energy.

b. Living things need food, water, air, space, and protection from enemies and adverse physical conditions.

c. Different plants and animals require varying amounts and kinds of each of these factors.

d. Living things need energy to stay alive and to grow.

1. Ask students if they could survive if any of these things were missing from their environment. This is an excellent time to introduce and discuss this word. Here the students can see that they are a part of and dependent upon their environment.

a. If the environment of a plant or animal does not supply its need, the organism either adapts, moves away [animals] or dies [plant or animal].

1. Man, who is an animal, because of his brain and physical development, usually adapts.

a. Stress that man though classified as an animal is endowed with certain characteristics wich sets him apart--brain--thumb--mobility.

3. Plants - the basic source of food.

a. Every plant and animal [including man] depends on other plants and animals. Each one gets something from its environment and gives something to it.

1. Green plants are the only living things capable of converting the energy into food.

2. The four essentials needed for green plants to make food are: sunlight, air, water and minerals.

a. These words should be introduced: Photosynthesis, Chlorophyll, Oxygen - carbon dioxide cycle, Water Cycle, Nutrient [decomposition] cycle

1. Decomposers

b. Expand the idea of cycles, as introduced through H2O, OO2 - O2 cycles, to include the concept that everything changes.

Suggestions:

1. Compile a list with the students of all the changes that are going on at the time outside their school. This might include: temperature, clouds, position of sun, changes in trees, weathering of building materials, amount of litter in streets, fallen leaves which have collected at base of fence or tree, and have begun to turn to soil.

2. If a terrarium is available help children to discover the water cycle.

3. Look for microclimates, or little environments, in a nearby vacant lot.

4. Food Chains - a. Energy is transferred from green plants [producers] to other living things [consumers and decomposers] through food chains. b. Some animals [herbivores] eat plants; others [carnivores] eat animals which eat plants. c. Non-green plants [e.g. bacteria and fungi] and some animals [e.g. snails, millipedes] are decomposers, which feed on decaying plant and animal matter. d. Decomposers cause formation of the rich, dark topsoil called humus. Give example of food chain; have students develop other food chains.

5. Climate - the controlling factor for various biomes. Time spent developing this should be limited. Children should know that different plant and animal life exist in the different biomes. However, a brief review or introduction to this concept should be sufficient at this grade level.

Biomes - 1. Tropical forest biomes. 2. Deciduous forest biomes. 3. Coniferous forest biomes. 4. Tundra biomes. 5. Greenland biomes. 6. Desert biomes.

6. Soil - The supporter of Our Environment - This discussion can be done outside, using worksheet.

1. Soil Conservation
    A. Erosion
    B. Formation
    C. Importance
        1. grasses
        2. perculation test if possible
    D. Is every person either directly or indirectly dependent on soil?
    E. What problem does an increasing population place on man and his use of the soil?
    F. Earthworms and their importance to the soil.
    G. Soil testing.

WHAT ANIMALS OR ANIMAL SIGNS CAN YOU FIND AROUND YOUR NEIGHBORHOOD?

I. You often know animals are around, or have been around, even though you don't see them. Remember that man is an animal. Here are some ways you can tell that he has been around.

1. Stand outside your school. Close your eyes. Listen. Open your eyes and check all the sounds you heard that were made by man.

___footsteps
___talking
___laughing
___singing
___airplanes
___car horns
___trucks
___whistles
___cars
___music
___hammering
___foghorns
___motors
___trains
___sanitation trucks

Did you hear any others? ___yes ___no

2. Animals sometimes leave signs that they have been around. Think of signs which show that people have been outside your school. Check all the signs you can find.

___cigarette butts
___candy wrappers
___broken glass
___soda cans
___soda can openers
___gum
___newspapers
___gum wrappers

Did you see any others? ___yes ___no

II. Other animals besides man live in the city. You can find out who they are by seeing them, hearing them, or seeing signs they left.

1. Check all the animals below that you see on your walk.

___dog
___worm
___centipede
___cat
___spider
___millipede
___horse
___moth
___cowbug
___squirrel
___butterfly
___roach
___ant
___beetle
___caterpillar

Any others?

2. Check all the animals you hear on your walk.

___dog
___cat
___bird
___horse

Any others?

ANT WATCHING

Look for a patch of grass, soil or sidewalk and watch for ants.

1. How many kinds of ants do you see? ___one ___two ___three ___more than three

2. How are they different? ___size ___shape ___color ___other ways

3. Look at one ant closely. Use a magnifying glass.
How many legs does it have? ___
Does it have antennae, or "feelers"? ___yes ___no
Does it have wings? ___yes ___no
Does it have eyes? ___yes ___no
How many parts does its body have? ___one ___two ___three ___more
Draw a picture of the ant here. Put a number on each of the body parts.

From which part of the body do the legs come?
___first part ___second part ___third part

4. Watch an ant that is carrying something. What is it carrying?
___food ___white pupae ___something else
How big is the ant? Show on the line below.

____

How big is its load? Show on the line below.

____

Does it keep moving? ___yes ___no
Does it stop and go? ___yes ___no
Does it move in the same direction all the time? ___yes ___no
What happens when it meets another ant? ___backs away ___goes around it ___fights
___works with it ___something else
Does it act the same with all the ants it meets? ___yes ___no
Put something in the way of an ant that is carrying a load. What does it do? ___backs off
___goes around ___drops its load ___crawls over it ___something else

5. Look at an ant hill. What is it made from? ___soil ___twigs ___leaves
Draw a picture of an ant hill.

6. Put a piece of food a short distance from an ant hill. Use a watch to time how long it takes before the first ant finds it. What does the ant do when he finds it? ___tries to pick it up ___pushes it ___pulls it ___leaves it
Do other ants come? ___yes ___no How soon? ____________ How many? ____________
What happens when more than one ant finds the food? ___they work together to pull it
___they fight over it ___some stay and others go.

7. Put a small piece of meat, a small piece of bread, a little sugar and a little lettuce on the ground. Watch until an ant comes. Which kind of food does he go to most?
___meat ___sugar ___bread ___lettuce ___no difference

WHAT KINDS OF PLANTS ARE IN YOUR NEIGHBORHOOD?

Take a walk around your school. Look for plants.

I. Some of the plants you see were put there by people. Circle all of the plants below that you can see.

Trees
Shrubs
Hedges
Flowers from bulbs
Vines
Grass
Flowers from seeds

Look close at the trees. Do you see any trees that look like this?
___yes ___no

Any that look like this?
___yes ___no

Which tree keeps its leaves all winter? Put a circle around the picture of it.

Look closely at a shrub. Can you tell a shrub from a tree? ___yes ___no
How many trunks does the shrub have ___ How many does a tree have? ___

II. Some of the plants you see were not put there by people. See how many of these you can find and where you can find them.

Places you find plants [put a check]	Kind of plant [draw a line to the place you found them]
___cracks in sidewalks	moss
___around telephone poles	dandelion
___around street trees	other wildflowers
___in vacant lots or strips	mushrooms
___on lawns	weeds with flowers you can't see
___some other place	grass

FINDING OUT ABOUT THE SOIL

I. Take a walk in your neighborhood. Circle all the places you find soil.
On the lawn.
In the vacant lots.
In the islands around street trees.
Around bushes or shrubs outside the school.
In cracks in the sidewalk.

II. Find out things about the soil in different places:

1. How hard is the soil? To find out, touch the soil with your finger. Next, push a pencil into the soil.

2. How fast does water soak into the soil? To find out, use a juice can with both ends removed. Drive the can one inch into the soil. Fill the can with water. Wait two minutes. Measure how much water soaked into the soil.

Enter your findings for both tests on this chart:

Place	Touching soil with finger	Pencil test	Amount of water that soaked into soil
	very hard/hard/soft		
On the lawn			
Around shrubs			
Vacant lot [grassy]			
Vacant lot [bare]			
Island around tree			

III. Study soil in two different places. Write down what you find.

Place 1	Place 2
A bare spot [around a street tree; a short-cut through a vacant lot.	A grassy spot on a lawn or vacant lot.

1. Dig up a spoonful of soil. Check all the things you find in it:
   - pebbles
   - sand
   - twigs
   - leaves
   - weeds
   - insects
   - worms
   - silt
2. Check the color of the soil:
   - tan
   - brown
   - red
   - black
3. Does a magnet pick up any of the soil? ___yes ___no

4. Roll a little ball in your hands. Add enough water to make it roll easily. Now roll the ball into a soil"snake". Circle the way the snake looks.

WHAT ARE SOME WAYS PEOPLE ARE HURTING THE ENVIRONMENT?

I. Air Pollution:

1. Stand outside your school. Look all around. Check all of the places you can see that air pollution is coming from:

___factories
___apartment houses
___cars
___buses
___airplanes
___fires

2. Describe the sky. Is it clean? ___yes ___no
Is it hazy? ___yes ___no
Is it darker in some parts than others? ___yes ___no
3. Can you smell the air? ___yes ___no
4. Do your eyes tear or smart? ___yes ___no
If possible, watch the bus leave the bus stop.
Can you see the exhaust? ___yes ___no
Can you smell the exhaust? ___yes ___no
5. Try to collect some pollutants.

a. Wipe a car with a tissue. Paste a piece of the tissue below.

b. Wipe a window ledge with a tissue. Paste a piece of the tissue below.

c. Go to a tree near a bus stop. Wipe a leaf with a tissue. Paste a piece of the tissue below.

d. Go to a tree as far away as possible from bus stops and heavy traffic. Wipe a leaf with a tissue. Paste a piece of tissue below.

e. Sandpaper a small section of the stones on the outside of the school building. Is there a difference in color? ___yes ___no

7. If there is snow on the ground, what color is it? ___white ___gray
How long ago did the snow fall? ___today ___yesterday ___a few days ago

II. Litter:

Examine the litter under a tree, on the grassy strip between the sidewalk and the street, or in a vacant lot. Check the things you find. Some of these things will come apart soon. Some will last a long time and make the ground ugly. Draw a line from each thing you found to the right group.

GROUP 1		GROUP 2
Things that will make soil soon:		Things that will not make soil soon.
	newspapers can glass soda can tabs foil candy wrappers cigarettes	

LANGUAGE ARTS

Time: 45 minutes

CONCEPT: All experiences are interpreted by the senses.

OBJECTIVES: To promote curiosity and awareness through the use of the senses. To help children realize there are many forms of communication. To develop an awareness of words as symbols.

VOCABULARY: Communication - Senses - Imagination

ACTIVITY I: Communication [Materials: Sugar - Fat] Teacher picks 1-2 activities. Start with discussion: Do all living things communicate? Do they all have voices like we do? Can plants tell you things? Animals? How about Insects?

Have children sit in circle and tell them they will have to communicate with each other without sound. To start them off, mimic the fact you want something to drink or eat. Give each child a chance to communicate his own idea to the group. See if anyone can communicate without hands or voice, without moving, etc.

2. Using the Senses [Vocabulary Building]
Tag game for texture. Children are given sensory words on tags, then asked to match them to the real thing. If enough time, they can swap tags and do it again. As a small group they then explain their choice to others.

3. Using the Senses. [Awareness]
The group chooses partners. One is blindfolded and the partner records what he hears and smells. Have each child also collect three items and see if blindfolded partner can identify by touch. When each partner has had a turn, check both lists for accuracy.

4. Using the Senses [Words as Symbols]
Start with a discussion of how many times we describe things by comparing them to other things. Example - "Johnnie eats like a horse" - "She is a nut". Talk about figurative speech verses factual speech. Explain that we are going to try using figurative speech.

Have them find an object [stick, leaf, rock, etc.]. Bring it back to the group, feel it, look at it carefully, check its color and see if it smells. Now tell them to think of something that it reminds them of. Repeat for a total of two objects. Now, have them write a sentence stating "My ________ reminds me of ________". Next, cross out the words "reminds me of" and put in "is". Discuss why they now have a figurative sentence. Keeping their object hidden, have them read the last part of the sentence and see if the rest of the group can guess the actual object. Then with the same two objects write a descriptive factual sentence.

a. Follow up in class reading. Have children pick out figurative sentences in regular reading.

b. Use the unit in Science or Social Studies to do figurative writing. [Stars - Indians, etc.].

5. Likeness and Differences [Record Keeping - Shapes and Pattern]. Have each child compare two things outdoors. Bush to Tree - Different Leaves - Stems - Rocks - Birds.

LANGUAGE ARTS EXPERIENCES OUTDOORS

The out-of-doors provides opportunities for creative writing as well as note-taking and other forms of language arts experiences. Good planning is vital if the experiences are to be satisfactory. If children are to write, they should have experiences to make them aware of topics for their writing.

1. Sensory exploration of natural phenomena:

a. Have the students close their eyes; touch bark leaves, feather, rock, etc.; then let them describe what the object feels like. Let several persons use descriptive terms to tell what the object feels like. Use the other senses in similar activities.

b. Have them play games in which attempts are made to describe objects using similies, metaphors, or comparisons.

c. Have the students make up short rhyming descriptions or list as many terms as possible that describe a phenomena.

2. Use the environment to set a mood. Look out over a vast expanse; look up through the trees to see the patterns of leaves; examine a hole in the ground or in a tree.

a. Ask for short verbal reactions to common and uncommon objects and surroundings.

b. Select poetry and stories to read, appropriate for the environment in which you are working. [Read poetry about trees and forests when in a wooded areas.]

c. Concentrate on a series of short phrases before getting into stories--Haiku poetry is a good introduction to writing for children in the intermediate grades as is writing lyrics to songs about their experiences.

Have the children make two lists. 1. How objects are alike. 2. How objects are different. Such as feel, weight, color, texture, shape, size, etc.

6. Make a log or diary about a tree or bush on the grounds.
7. Introduce new words by labeling with dirt or sand writing.
8. Take an alphabet hike - a natural material for each letter.

CLASSROOM ACTIVITIES

1. Creative Writing For Good Readers

a. Story about what large tree has been seen in the community since it was a sapling. Changes in enviornment, visitors, etc.

b. Find three beautiful or ugly things in your school or community and why they are this way.

c. Write an imaginative story of what will happen to the school community in the future.

d. Describe your school as if you were a visitor from outer space.

e. Haiku or Quantrain poetry.

f. Have a small group write a "Sound Story" or "Play".

g. Write commercials to advertise benefits your school has or "Help Wanted" ads for school improvements.

2. Make word jumbles on sensory words.

3. Dictionary Work for Describing Words. Keep a part of a bulletin board for newspaper articles on science subjects or conservation. Have discussions centering on how, if at all, these affect the children, school community or environment.

4. Have children make "Picture Stories" of outside activities. The better ones could be laminated for use by slow readers who could write words to go with pictures.

5. Litter clean-up. Before and after pictures and poems or descriptions and study.

6. Letter writing to different departments listed in resources.

Follow-up in class:

1. Discuss how your animals at home let you know what they want.
2. Play charades.
3. Find pictures of interesting faces or poses of animals or humans and let children write captions for them.

ACTIVITY II: How would you feel? Creative Writing and Awareness. [Materials: Pencil - paper or something to write on - small plant - insect or rock on ground]

1. Start by asking children if they have ever wondered what it would be like to be very different from what they are.
2. Have them pick an object to be from the materials.
3. Have them get as close as possible to that object.
4. Ask the following questions and have them record answers using sensory words.
   a. What can you see?
   b. How would people look?
   c. How would footsteps sound?
   d. What else could you hear?
   e. Whowwould your neighbors be?
   f. What visitors would you have?
   g. Would you be hot, cold, wet, or dry?
   h. What would make you happy?
   i. What would frighten you?
   j. Would you rather be yourself - why?

FOLLOW UP:

Take answers back to class and write a story of your life as the object lesson.

ACTIVITIES ON SITE FOR CLASSROOM TEACHER:

1. Communication: Have group stand quietly around a tree and ask:
   a. Can a tree tell you anything?
   b. How would people look?
   c. How would footsteps sound?
   d. What else could you hear?
   e. Who would your neighbors be?
   f. What visitors would you have?
   g. Would you be hot, cold, wet, or dry?
   h. What would make you happy?
   i. What would frighten you?
   j. Would you rather be yourself - why?

FOLLOW UP:

Take answers back to class and write a story of your life as the object chosen.

ACTIVITIES ON SITE FOR CLASSROOM TEACHER:

1. Communication: Have group stand quietly around a tree and ask:
   a. Can a tree tell you anything?
   b. Are the leaves green, brown, or gone? What are the leaves telling you by the way they look?
   c. Look at the bark - is it scarred, healthy, smooth, has holes, or cracked?
   d. Is this tree communicating something by its condition?

ACTIVITIES TO SHARPEN THE CHILDREN's SENSES

1. Discover objects relating to texture which can be described as slick, hard, rough, soft, slimy, velvety, coarse, knobbed, ribbed, furry, hairy, waxy, etc.
2. Discover objects relating to shape which can be described as small, large, oval, round, oblong, lobed, ridged, smooth-edged, rough edged, triangular, pointed, curved, billowy, horizontal, expansion, contraction, etc.
3. Discover objects relating to density which can be described as spongy, solid, thick, lumpy, hollow, compact, porous, non-porous, etc.
4. Discover objects relating to temperature which can be described as hot, cold, damp, clammy, moist, dry, wet, cool, lukewarm, etc.
5. Discover objects relating to size which can be described as narrow, large, small, tall, short, thick, heavy, bulky, miniature, etc.
6. Look for evidence of life above and around water including insects, turtles, algae, and other plankton, worms, frogs, etc.
7. Observe the differences in the bark of trees. Some may be shaggy, some will look like the shapes and colors found on the backs of certain snakes, some will have warts like projections, some will have deep ridges, etc.

[Could be used for a "collection table" in the room with children bringing in the materials.]

SF Shapes and Patterns

MATERIALS NEEDED:

Pencil and paper.

OBJECTIVES:

Given a set of articles in a natural environment, students should be able to list them in order of relative size, from the largest to the smallest.

Students should be able to find leaves or at least three different shapes, and be able to sketch shapes seen in flowers, trees, clouds, and other natural phenomena.

THE TRIP:

What shapes can you see? Are all trees shaped the same? Sketch a few. What shape is a leaf? Trace at least three leaf outlines. What shape is a flower? Find one that is bell-shaped, triangular, round. What shape is a cloud? Try to sketch some. What happens while you draw? Can you find a triangle, a rectangle, a square, a circle, etc?

What sizes can you see? List some things you can see starting with the biggest thing and getting smaller until you reach the smallest thing you can find. What things can you see that can be both big and little?

What patterns can you see? Sketch some. Can you find patterns in the bark of trees? Can you see patterns in plants, birds, insects and other animals?

Can you find a tree that reminds you of something: A figure? A vase? Etc.

Can you find a texture in some natural object that you would like in cloth? What would you make from such cloth?

Can we see fall? Spring? What colors can you see? How do they differ from the colors of other seasons? [Or the colors of two or three months ago?] Is the grass all green? All the same color green? Is the sky blue? What color is a flower? What color is a tree? What color is sunshine? What color is rain? What color are clouds?

What shapes can you see? Are all trees shaped the same? What shape is a leaf? Draw some leaf outlines. What shape is a flower? What shape is a cloud? Can you find a triangle, a rectangle, a square, a circle, etc.

What sizes can you see? List some things you can see starting with the biggest thing and getting smaller until you reach the smallest thing you can find. What things can you see that can be both big and little?

What patterns can you see? Can you find a tree that looks like something else? Can you see patterns in clouds, rocks, grass, water, etc.? Can you see patterns in plants, birds, insects and other animals?

> How do you know it's Spring
> And how do you know it's Fall?
> Suppose your eyes were always shut
> And you couldn't see at all.
> Could you smell and hear the Spring
> And could you feel the Fall?
> Margaret Wise Brown

Descriptions

Write a group story using as many descriptive words as possible to describe:

smells
colors
textures
sizes

Example: We went to a park. We saw big trees
tall trees
short trees
green trees
brown trees
wide trees
thin trees

The kinds of bark on the trees were different.
Some bark was smooth
rough
bumpy
lumpy

Descriptions

What did you see, hear, feel, smell or taste that could be described by the following adjectives?

hard soft green shiny rough smooth

red yellow beige large shrill sweet

DISCOVERING YOUR ENVIRONMENT

Colors

Most people having normal eyesight recognize colors found in objects, but few understand what causes an object take on a certain color appearance. A simple scientific explanation is that when light rays strike an object all the colors are absorbed except the one[s] that is reflected and reaches the human eye.

How many colors do you find in a large crayon box? Many, of course, is the answer. But there are many colors in the school building and on the school ground which are taken for granted because people seldom look for them. This experience will help you develop an awareness to colors in the school environment.

OBSERVATIONS AND PROBLEMS

1. Examine very carefully the exterior walls and doors of the school building. Record the number of times the following colors are found. Brown_____ Yellow_____ White_____ Black_____ Red_____ Green_____ Blue_____
2. What colors seems to dominate or occur most frequently in the exterior walls when you are standing away from the school building and looking at the whole building?_____ and _____.
3. What color is most commonly found in the stone portion of the building?_____
4. What color is most commonly found in the wood portion of the building?_____
5. What color is most commonly found in the plastic and glass portions of the building? _____
6. What color is most commonly found in the metal portion of the building?_____
7. There are many different shades of green. Look carefully at objects found on the school grounds, excluding the school building, and count the number of different shades of green you can find._____
8. Go to the school parking lot. Record the number of cars painted the following colors: Brown:_____ Yellow:_____ White:_____ Black:_____ Red:_____ Green:_____ Blue:_____ Two-toned:_____
9. Observe for 10 minutes automobiles passing school building. Which color did you find occurring most frequently?
10. Look up toward the sky. What colors do you see?_____, _____, and _____
11. What are your two favorite colors? _____ and _____. Name two objects found on the school ground which are primarily this color. _____ and _____
12. Look at the children playing on the school ground. What color occurs most frequently in the clothes they are wearing? _____

GOING THE NEXT STEP

1. Imagine a world in which everything is of one color. Write an essay or story about this world and the life of an animal in it.
2. The part of the earth covered with green plants is being reduced as man constructs more cities and roads. May the future effects of this reduction in the area be covered with green plants?
3. Conduct an investigation among your classmates, or a group of adults, to determine color preferences in clothes, automobiles, and houses.

Correlated ideas with other subject matters

1. Social Studies

Research as to history of site

Creative writing as to what this area would have been like in the days of Indians, Pioneers, what materials would they have used to live that are still here? What food animals no longer live here. Were things changed slowly? Quickly?

What could be used most easily as shelter using local materials?

What would grow here to feed people?

2. Science

Record keeping to types of plant, animal and insect life still found here, also record of type of weather--sensory poetry of weather.

Fossil study - creative stories of what site was like millions of years ago; before last ice age; during it.

Conservation studies - letters for help with problem.

3. Math

Records of measurement acres of land; on school site; measurement of grassland concrete or blocktop [at end of year fractions of 2] height of building, trees, flagpole, compass study of site - using material for learning how to read graphs, estimation, measuring circumference and diameter of trees, poles, etc.

RESOURCES - FROM ENVIRONMENTAL EDUCATION CENTER

Books:
PROBE, Educational Service, Inc.
CURRICULUM ENRICHMENT OUTDOOR, Chapter 3, Harper & Row
ABOUT FOUR SEASONS AND FIVE SENSES, Melmont Publishers
BAKER NATURE STUDY PACKET [found in local schools]
THE LITTLE NATURALIST [poetry], Whittlesly House, McGraw - Hill
BIRDS, FROGS, AND MOONLIGHT, Haiker, Cassedy and Suetake, Doubleday & Co.
STORIES IN TREES [legends], Mary Curtis, Lyons & Carnahan
USING SCHOOL & COMMUNITY, Teachers handbook

ROCKS AND FOSSILS

One Session - 45 minutes

CONCEPT: Rocks and fossils are interesting to collect and study. They tell the story of what the earth was like long ago. Rocks can tell us how the earth has changed in many ways.

BEHAVIORAL OBJECTIVES: Students will learn that minerals occur naturally in the earth and that rocks are composed of two or more minerals. They will learn something of their uses and value to man.

Students will learn to identify some basic minerals, rocks, and fossils. Ways of testing a rock to discover its identity will be learned. Rocks and fossils will be examined and students will be given opportunity to search for samples. Methods of collecting specimens will be shown.

VOCABULARY:

anthracite
bituminous
brachipods
crinoid
crystal
feldspar
flint
fossil
geologist
gneiss
granite
igneous
lava
limestone
magma
metamorphic
mica
mineral
pressure
quartz
sandstone
sedimentary
shale
stalactite
stalagmite
trilobites
volcano

STAFF ACTIVITIES: Students will discuss the three rock families briefly and discover how they were formed. Examples of each, [i.e., igneous, sedimentary, and metamorphic] will be displayed. Examples of fossils will also be shown and discussed.

A brief discussion on fossils and their importance in revealing the past will be conducted. Examples of common types of fossils will be shown to the students. Fossil charts, books, and guides on rocks and minerals will be used as an aid in discovering as many different kinds as possible.

Outside, the students will find limestone and test it by using vinegar. Rock hardness kits will be used so that each student will be able to test a specimen for hardness in comparison to other specimens. Streak tests will also be taken as well as observing color, luster, crystal form, and specific common minerals in order of increasing hardness. The hardness of an unknown mineral can be determined by observing which mineral on the scale gives a clue to its identity.

Various specimens will be examined under hand lens and differences in size and shape of the crystals will be noted as well as differences in color. Good methods of collecting specimens will be shown. Each student will be given ample time to explore and search for good rock and fossil specimens. The students will be encouraged to start collections of their own.

QUESTIONS TO BE ANSWERED:

What is a rock? What is a mineral?
Where are minerals found?
How do rocks tell a story?
What are the three rock families?
How are each of these kinds of rocks formed?
What are some uses for rocks?
Do rocks change?
Can you tell how hard a rock is? How?

What is a fossil?
What stories can fossils tell?

Are fossils rare?
Can you find very many fossils in Tennessee?
Name different kinds of fossils.
What kind of work does a geologist do?

FOLLOW-UP ACTIVITIES FOR THE CLASSROOM TEACHER

1. Go on a hunt for rock in the school building. Children will observe natural stone in the classroom; windowsills, stone steps, the outside wall of the school building, also man-made rock such as concrete, bricks, and tiles.

After the trip, ask the children why rock is so useful. Discuss rock as a basis for building materials. These are selected for their strength, their resistance to fire and water, the ease with which they can be shaped, and for other qualities.

2. Have the students explore their neighborhood for rocks to bring to class. Undoubtedly, the collection will include some man-made rock such as fragments of brick, concrete, and others. Have each child talk about his "find". Encourage them to talk about shape, color, texture, size, and weight of the samples. Ask the students to suggest ways of organizing their collection. Some may wish to group the rocks according to size; some, according to color, and some will suggest other ways.

3. Show the children pieces of coarse and fine sandpaper. Let them investigate and guess how it was made. Have the students make sandpaper. Spread a mixture of mucilage or glue and water on brown wrapping paper. Scatter sand lightly and evenly on the glue. Let the glue dry. Try the sandpaper on wooden blocks.

4. Ask students to bring to class small rocks that they find on the way to school. Have each pupil tell how and where he found his rock. Ask which rocks are parts of buildings, sidewalks, curbs, and so on. Ask children if they have ever seen men making rock. If possible, visit a construction site where concrete is being mixed and poured to make sidewalks, or building blocks. Perhaps the custodian may show children how he mixes and pours concrete to repair breaks in school concrete. Have the students make an exhibit of two groups of rock, man-made and natural.

5. It is possible to grow beautiful crystals with powdered alum. This may be purchased at a grocery or drug store. Heat some water until it boils, then put the water into a cup. Add a large spoon of powdered alum to the hot water and stir with a spoon until the alum dissolves. Keep adding more alum, stirring all the while, until no more will dissolve. Now wrap one end of a string around a small stone and lower the stone into the water. Let the other end of the string hang over the side of the cup. Let the water cool slowly. After an hour, take the string out of the water. Beautiful crystals of alum will have formed on the string. Look at the crystals with a microscope.

6. Put some damp clay into the bottom of a small cardboard box. Press a shell, a bone, or a seed pod into the clay, making a deep print. Remove the plaster of paris with enough water to make it as thick as condensed milk. Mix it in a milk carton or clean tin can. Pour the mixture into the mold and let it set for several hours. When it is hard and solid, lift it out carefully. A good mold should result in a good cast. The cast represents another kind of fossil.

ENRICHMENT ACTIVITIES FOR STUDENTS:

1. Develop a method of classifying fossils by determining how many different kinds can be found.
2. Compare rocks according to color, color streak, texture, hardness, luster, fabric, fracture, density and other characteristics.
3. Find examples of how rock and man-made stone are used by man.
4. Using a geologic map of the area, find various kinds of exposed rock formations.
5. Start a fossil collection and give information about your collection to the class.

SOIL

One session.

CONCEPT: Soil is composed of both living and non-living things. Animals and plants depend on soil. Both water and wind can carry soil away.

BEHAVIORAL OBJECTIVES: Students will learn that soil is made up of many different things. They will find out that soils are formed mostly from rocks that have been broken into very small pieces.

Students will discover other ways that soils are formed. They will learn to test soil and to interpret the meaning of the test. Each student will learn something of the causes and prevention of erosion. The interrelationship between all living things and the soil will be stressed.

VOCABULARY:

bedrock
chemical
elements
erosion
fertilizer
gravel
horizon
humus
layers
leaching
lichens
loam
moisture
silt
soil profile
subsoil
topsoil
weathering

Staff Activities - Each student will be helped to see that soil contains many different things. These things include air, water, rock matter, dead organic matter, and living organic matter. The harmful effects of erosion will also be discussed and, if possible, pointed out.

Students will examine various soils with hand lens and notice differences in the size of particles. Other differences may be noted. Dust made from rubbing rocks together will be examined. Similarities and differences in particles will be noticed. Conclusions should be reached on how soil is formed. Examples and illustrations will be given to show how living things depend on soil and soil on living things. Temperatures at various levels will be measured.

QUESTIONS TO BE ANSWERED:

What is soil?
What things are in soil?
How is soil formed?
How is soil moved from place to place?
What is meant by a soil profile?
What are some differences between topsoil and subsoil?
How does weathering help make soil?
What is erosion of soil?
How can erosion be prevented?
How does soil help all living things?
Do you know how to test soil?

FOLLOW-UP ACTIVITIES FOR THE CLASSROOM TEACHER:

1. Dig up one-half square foot of untrampled soil four inches deep. Tear apart and count the number of animals. Multiply the number found by two to find out how many are in one square foot. Multiply this by 43,560 to find out how many in an acre. [In an acre of topsoil there may be 50,000 earthworms. These can bring eighteen tons of subsoil to the surface yearly, building a three inch layer of top soil in twenty years.
2. Collect soils from different places at the surface of the school yard, home yard, and any woodlots or fields in the neighborhood. Put a sample of each soil type in a test tube or bottle of water. Describe what happens. Cork the bottles and shake each. Let the bottles stand and watch the soil settle. Observe at intervals of fifteen minutes. Record results. How long is it before the water in each tube is completely clear? Which soil type settled most quickly? Which took the longest to settle? Why do you think this is so?
3. Combine several different types of soil, sand, gravel, silt, clay and loam. Add water to just-more-than-cover. Shake, observe the settling action. After 24 hours observe sediment layers and have students draw what they see.
4. An entire year's study might develop from the investigation of topsoil in the area. What is topsoil composed of? How thick is it in an undisturbed area near the school? If it takes three hundred years to make an inch of topsoil, what has gone on in this spot since the first soil was formed? Discussion of these topics could lead to further research into science, history, and literature. Mathematics can also be used in setting up time lines and determining relationships.
5. After a hard rain, have the children collect the soil that has washed into the street or along a section of the curb. Place this soil in a box, and have the children determine its volume to find out how much soil was washed away at the place where they collected it.

ENRICHMENT ACTIVITIES

1. Collect two cans, two glass containers, a hammer and nail, humus, and sand. Hammer the nail through the bottom of each can. Make a few holes in each. Place each can over one container. Pour the humus into one can three-fourths full, and sand into the other in the same amount. Pour an equal amount of water into each can. The water should flow through the sand faster than the humus because there are more empty spaces in the can of sand. Humus holds water better because it is a more solid mass.
2. Spread soil evenly over a one foot square board. With a pencil, plow the field in a horizontal semi-circle. Tilt the board to represent a hillside. Spray water on the top of the hill. Observe that the water stays in the irrigation ditches and does not run down the hill. Do the experiment again. This time, plow the ditches downhill. What happens?

Grooves plowed correctly save the seeds, plants, and soil from being washed away during rain.
3. Collect a small quantity of dry soil and weigh it in a tin can. Burn the soil in the can until all organic matter is destroyed and weigh the residue. What part was mineral matter and what part was organic matter?
4. Study the effect of vegetation upon soil temperature by placing two thermometers at a depth of one inch in two plots, one covered with vegetation and the other in bare soil. Take readings and compare the differences.
5. Fill two jars or cans with different types of soil - one with loose light soil and one with hard-packed soil. Drop one or two earthworms in each jar and watch to see which one burrows to the bottom first. Explain the statement that the earthworm is a soil builder.

CORRELATED ACTIVITY SUGGESTIONS

Art

1. Dig up a spoonful of soil. Sketch all the things found in this soil. Examples may include pebbles, sand, twigs, leaves, weeds, insects, worms, and silt. Include the colors of the soil.

Multi-Purpose

2. An interesting experiment can be conducted by exchanging a square of sod (perhaps a ten-inch square) from one type of area with one the same size taken from an area of a different type. Have the class observe the results to see which plants in each square of sod will be able to survive in the new environment.

For example, the class might spade up and exchange a square of soil from one area into another and watch the results.

Correlated Ideas for Use with Team and Departmental Programs

SOCIAL STUDIES

1. Compare kinds of rock used (sandstone, soapstone, marble, granite) on headstones in a cemetery. Prepare reports on former and present methods of stone-cutting. Discuss transportation problems of the earlier days. A study of veterans' gravestones could interest some children in knowing the causes for which those men fought. Customs of earlier Memorial Days might become a subject for research.

MATH

2. Have the children collect stones of various weights to bring into the classroom for weighing. Stones ranging in weight from less than an ounce up to five or ten pounds should be obtained.

Label ten or more stones of various weights and have each child lift and estimate the weight of each of these stones. Then weigh the stones and let the children find out how close their estimates were to the correct weights. Repeat these procedures, using different stones, and let the children discover how much they have improved in judging weight.

ART

3. Sketch a picture lightly on a piece of colored cardboard. Then paint one section of the picture at a time with an allpurpose glue or with rubber cement, and quickly sprinkle sand on it. Shake the excess sand from each section before working on the next section.

The natural color of sand makes an effective contrast with a colored background. If colored cardboard is not available, you may wish to paint the cardboard and give it time to dry before applying the sand. Also, a special effect can be obtained by coloring some of the sand by rubbing a few drops of poster paint into it.

RESOURCE MATERIALS

Using Natural Resources--Game and Poster Cards, Milton Bradley Company

Conserving Natural Resources--Game and Poster Cards, Milton Bradley Company

Today's Basic Science, by Navarra and Zafforoni

Rocks and Minerals, by Lou Page

Science in Your Own Backyard, by Elizabeth Cooper

Curriculum Enrichment Outdoors, by John Hug and Phyllis Wilson

Tips and Tricks in Outdoor Education, by Malcolm Swan

Golden Stamp Book of Rocks and Minerals, by Paul Shaffer

Science Projects You Can Do, by George Stone

Earth and Its Resources, from Board of Education, New York City

The Earth and Its Story, by Lou Page

Rocks and Minerals--A Golden Nature Guide

Fossils--A Golden Nature Guide

Filmstrips on rocks and minerals; various activities and pamphlets also available for individual use.

Films:

Fossils Are Interesting - Sc 586

History of Living Things - Sc 584

How Solid Is Rock - Sc 611

Minerals and Rocks - Sc 491

Prehistoric Animals of the Tar Pits - Sc 426

Rocks and Minerals - Sc 419

Rocks in Our Neighborhood - Sc 587

Rocks that Reveal the Past - Sc 589

Message from A Dinosaur - Sc 621

MORE RESOURCE MATERIALS

Curriculum Enrichment Outdoors, by John Hug

Object Lessons in Science, Delta Series

Nature's Bank--The Soil, by Mary Melrose

Discovering the Outdoors, by Lawrence Pringle

Object Lessons in Science, Epsilon Series

Science in Your Own Backyard, by Elizabeth Cooper

Soil, by Richard Cromer

The Natural History Guide, by H. Charles Laun

Tips and Tricks in Outdoor Education, by Malcolm Swan

Earth and Its Resources, Board of Education of New York City

The Dirt Book, by Eva Evans

The Earth, by Lawrence Hubbell

Experimental Discoveries in Nature, Grinnell-Heidrich

Soil Conservation Publications

Soil Means Life, by Fair C. Griffin

The Soil that Went to Town, S. Conservation Service

Our Soil Resource--3M Printed Originals for Overhead Projection Transparencies

Films:

Conserving Our Soil Today - Sc 338
Erosion--Leveling the Land - Sc 407
Life in A Cubic Foot of Soil - Sc 348
Earthquake - Tc 539

NOISE POLLUTION

This unit is suggested as a follow-up for Chapter 2 Discovering Science, or for Lessons 7 and 8, on the Science television program.

One Session.

CONCEPT:
Noise pollution is a very important and dangerous part of every day life.

VOCABULARY:

pollution
noise
sound
pitch
echo
sonar
decibel
acoustic
irregular
absorb
insulate
volume
frequency
vibrate
regular

OBJECTIVES:
1. Identification of sources of sound around school community.
2. Distinguish between necessary and unnecessary sound.
3. Have children attempt problem-solving.

Discussion by classroom teacher before we arrive of following pages of material with the children.

The teacher might try making a loud, unpleasant noise suddenly (bursting hidden balloon, nails on chalkboard, crashing yardstick on desk, dropping metal object, etc.) Then tell the children that any sudden noise of over 70 decibels can show
faster heartbeat,
drying of mouth and tongue,
dilation of pupils,
loss of skin color,
muscles that tighten or contract,
constriction of small blood vessels,
upset stomach,
increase in sweating,
anger, anxiety, and irritability.

Ask children if they felt any of these things.--Were they pleasant or unpleasant feelings?
Discuss the following facts:

1. People suffering from heart disease, asthma, ulcers, or stomach trouble can become sicker because of noise.
2. Noise can make us feel very tired.
3. Noise causes mistakes in works.
4. Noise can affect the brain during the time you are asleep.
5. Noise-interrupted sleep can have a damaging effect on sick or old people.
6. Noise over a period of time can cause deafness.

Be sure that children know what decibels are and have had a chance to look over decibel chart.

DECIBEL CHART

Noise over 80 decibels can cause hearing loss, either temporary or permanent; at 120, physical discomfort; and at 140, physical pain.

	Decibels
motorcycle	90-120
office tabulating machines	80
circular saw	105-116
drills, electric shovels, trucks in operation	180
loud radio	85
heavy street traffic	90
metal saw	110
quiet home	40
refrigerator	30-40
dishwasher	60-80
air conditioner	70
vacuum cleaner	70-85
disposal	90-100
power mower	98
city school playground	78
jetliner, 500' overhead	115
jetplane at take-off	150
sound of breathing	10
garbage collection	85
ringing alarm clock	80
conversation	60
rustling leaves	20
baby crying in same room	92
cars	65-85
busses	95 +
car horn	90
bulldozers	100 +
shot gun	130

This can be used as a comparison chart for other sounds; also for a bulletin board display with pictures of objects (possible caption: NOISE POLLUTION WON'T KILL YOU--IT CAN ONLY DRIVE YOU NUTS OR MAKE YOU DEAF!).

OUTDOOR ACTIVITY WITH STAFF:

Materials: 3 tape recorders, work sheet IV, pencil, paper, something hard to write on.
Have each group record sounds in three different areas around the school for five minutes per area.

Have children make a list of what they hear while recorder is on and be sure to mark on both tape and paper which area is being recorded.

After record is made, take time on each site (5 - 8 minutes) to discuss the following:

1. Which noises were necessary--unnecessary?
2. Which were most pleasant--unpleasant?
3. Are some things we hear considered sound, not noise?
4. Why is one sound more irritating than another?
5. Are irregular noises more irritating than regular noises?

Spend an extra few minutes at last area for comparison of sites.

1. Which area was the noisiest?
2. Use worksheet IV to see if children can estimate decibels and location of sound.
3. What single thing produced the most noise?
4. Does above average noise by engines and exhaust systems on trucks or cars usually mean that another form of pollution is present?
5. Does the noise bother people in the building--neighborhood?
6. Can anything be done to make the noises we heard, less?
7. What could you children do; who might help you? Try to bring in idea of community working together on common problem.
8. Do you think this problem was here when you were a baby? Will it be better or worse if nothing is done about it when you're 21?
9. Do you think the world is getting noisier--why, or why not?

Follow-up in room (one session).
Have children check their lists while tape is played. Have other groups listen and compare to see if they heard the same types of sounds. Then ask the following questions:

1. How many sounds did they miss--why?
2. Can you get so used to a sound you don't really hear it any more?
3. Did all groups hear the same things?
4. Which noises bothered the whole group? Only one group? None of the group?
5. Appoint a classroom recorder (a better reading student) while previous questions are being asked. Have a small group of children make a graph showing most common sounds, loudest, etc.
6. Compare lists or graphs with those done by different classes taken at other times of the day.

Outside:

Activities for classroom teacher--

1. Use traffic monitoring worksheet if this is a problem in your area.
2. Use Activity 3.
3. Use Activity 6 can be done individually.
4. Let the children use worksheet I in noise they make themselves or find around the school.

CLASSROOM ACTIVITIES

1. Have children make a list of noises that bother them the most; then interview parent or adult for another list of what bothers them. Compare lists; make a report on likenesses and differences.

2. Do activity I, II.

3. Try to find a room in which there is absolutely no noise. Sit quietly for five minutes. What sounds can you now hear that you couldn't hear before? Do the small sounds seem to get louder as time goes on? Can you find a completely silent place? Even if there were no "outside" noises, what "inside" (yourself) noises can you hear?

Correlated ideas with other subject matter:

Language Arts

1. Make a collection of words describing sound (whine, shout, rattle, snap, roar, wham, tick, murmur, shrill, etc.) and have children find pictures of objects to match the sounds.

Social Studies

History of noise of site--How has noise increased over period of time? What need caused it? Will it get better or worse if nothing is done?

Math

Use decibel chart to estimate sounds of site. Work on Loudness of Sound Vs. Distance--Fractions and Measurement. See activity 3 under Follow-Up for Teacher.

RESOURCES

Books from Outdoor Education Center

Pollution, Examining Your Environment, Mine Publications, Inc.

Noise Pollution, Teachers' Edition, Addison-Wesley Publishing Company, Inc.

Pollution, The Noise We Hear, Lerner Publications

Sounds and Silence, Environment Science Center

For Pollution Fighters Only, McGraw-Hill

The World Around Them, Environmental Education in the Urban Environment, Conservation and Environmental Studies Center

Environmental Education Manual, Page 89

Our Polluted Planet, Ambassador Press

Materials Center:

Films--

Noise is Pollution Too - Sc 617
Noise: Polluting the Environment - Sc 603

SOUNDMAKERS

Source of Sound	Source of Energy	Vibrating Part(s)
1. Drum	Muscular Contraction	Drumskin
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

HIGH & LOW PITCHED SOUNDS

Source of Sound	High Pitch	Low Pitch
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

Note:
Describe your findings in a general statement or rule of behavior.

VEHICLE TRAFFIC MONITORING WORKSHEET

Date & Day of Week	Time ____ to ____	Location (Name of street or streets at intersection)	Weather Conditions	Type of Street (one-way, expressway, etc.)	Direction of Traffic Flow (N, S, E, W)	Traffic Count				Other
						Cars	Trucks	Busses	Pedestr.	

NOISEMAKERS AND FEELINGS

Intensity of Common Sounds

Sound	Decibels
Threshold of Hearing	0
Sports Car	20
Electric Blender	93
Hammer	94
Loud Thunder	100-110
Power Mower	107
Rock Group	160
Threshold of Pain	180
Riveter	160
Jet Plane	150

Source	Location	Estimated Loudness in Decibels(use Chart)	Necessary (Yes or No)	How Did This Noise Make You Feel?

NOISE

Noise can be defined as unwanted sound. Music from a radio may be considered sound, but if you are trying to sleep and the sound from the radio is keeping you awake, it then becomes noise. Noise pollution occurs when people are subjected to an excessive amount of unpleasant sounds. These sounds may be unpleasant because of their loudness, shrillness, suddenness, or length of duration. Noise pollution can be a health hazard. Over six million industrial workers now on the job in the United States will be partially or totally deafened by factory noise.

A sound's loudness or volume is often measured in units called decibels. When you are breathing normally, the sound you are making is about 10 decibels. A sound volume of over 85 decibels can damage hearing. A power lawnmower produces approximately 100 decibels while a jet plane at takeoff produces 150 decibels. The most serious noisemakers are aircraft, railroads, and traffic.

The world around us is getting noisier very quickly. The overall loudness of the noise outside our homes is doubling every 10 years. Roaring motor vehicles, clattering garbage cans, blaring transistor radios all add their contribution. Inside the home, furnaces, dishwashers, television sets, air conditioners, have doubled the sound level in the past 40 years. Far more difficult to measure than the effect of noise on our hearing is the way that it bothers us mentally. It can cause a person to feel nervous, irritable, and anxious. The same sound affects everyone differently. To some people the sound of a car's engine is pleasant while to others it is unbearable.

ACTIVITY I:

Can listening to a loud sound for 15 minutes produce a temporary loss of hearing?

To try this activity, you will need a watch and a radio. Turn the radio up as loud as you can without the sound becoming painful. Place your ear close to the speaker and listen for 15 minutes. Turn the radio off and try to hear your watch ticking when you hold it up to your ear. Note how much time passes before you can hear the ticking of the watch again. Mark the volume dial of the radio so that the same volume can be used again. Repeat the experiment again the next day but only listen to the radio for 10 minutes. Try it one more time on the third day, but only listen for 5 minutes this time. Make a chart to record your observations:

Title: ______________________	Date: __________		
Listening Time:	Day 1 15	Day 2 10	Day 3 5
Time needed to hear ticking of watch			

DIGGING DEEPER:

Which length of listening time produced a longest time for which the watch could not be heard? Predict how long you would not be able to hear the watch if you listenened to the loud noise for 20 minutes, 30 minutes, and one hour.

What do you think would be the result listening to the loud noise for a month or more?

BRANCHING OUT:

Make a survey of your community to find as many places as you can where people listen to loud sounds for long periods or extremely loud sounds for shorter periods. Talk to some of the people there to see if you can notice anything unusual about their hearing--What could be done to aid people who must continually work near loud noises?

ACTIVITY 2:

How can a tape recorder be used to measure the volume of sound?

You will need a portable type of tape recorder, one which you can carry with you easily and use without having to plug it into an electrical outlet.

Some tape recorders have a winking glow light or a swinging needle to indicate how loud the sound being recorded is. To use this type of tape recorder as a measuring device, study the appearance of the volume indicator while the machine is recording some music being played on the radio. Select music that does not change from loud to soft too often or too suddenly. A news broadcast could also be used. Start with the volume control of the radio turned down very low. Gradually make the sound from the radio louder and louder. Observe how the appearance or position of the volume indicator changes and complete the chart given below:

Loudness of Sound from Radio	Appearance or Position of Tape Recorder's Volume Indicator
1. Extremely soft	
2. Very soft	
3. Fairly soft	
4. Soft	
5. Fairly loud	
6. Loud	
7. Very loud	
8. Extremely loud	

DIGGING DEEPER:

Which method would produce a more accurate measurement of the loudness of the sound?

Why would using a tape recorder give a more accurate result than would be obtained by just using your ears?

Why should several people's opinions be considered if the sound rating method is used?

Which method would be the easier and more convenient to use?

Would the age of the batteries in the tape recorder affect the results?

How could numbers be used in place of words to describe a sound's loudness?

ACTIVITY 3:

How does the distance one is from the source of a sound affect its loudness?

Select a day when there is almost no wind.
Use the tape recorder and one of the methods from the previous activity to measure the loudness of a car horn in the parking lot. Ask a friend to beep the horn for you. Measure or record the sound at intervals of 10 paces as you move away from the car. Plot the information you collect on a line map similar to the one shown.

What difference in sound loudness will the tape recorder show?

Which sounds do you think are the loudest?

(1) Different types of gasoline motors, such as a large truck, a car, a motorcycle, an outboard motor, and a lawnmower.
(2) A jet airplane, and a diesel locomotive. Test these when the motors are idling and the vehicle is stopped, and when the vehicles start to move again. It may be too difficult to get close enough to test these.
(3) The horns of automobiles from different countries.
(4) Different types of ambulance, police, and fire sirens.
(5) The television set operating at different volumes.
(6) One person whispering, talking normally, and shouting.
(7) Your school class whispering, talking normally, and shouting.
(8) Girls' voices, boys' voices, men's, and women's voices.

Which sounds were the loudest?
Which sounds were louder than a power lawnmower?
Which sounds appeared louder or softer because of the space in which they were contained?
Which sounds appeared to be made louder or softer for other reasons?
Which sounds would be harmful to human ears?
Which sounds predominated; that is, could be heard above the other sounds?

ACTIVITY 4:

Where does noise pollution occur in your community?

Record the sound of a gasoline powered lawnmower at a distance of three feet with your tape recorder. Determine how loud the sound is by using one of the methods from Activity 1. Sounds which are as loud or louder than this sound can damage our hearing. Record sounds in as many of the following locations as you can:

(1) busy street corners in your neighborhood;
(2) busy streets downtown;
(3) In a railway station when trains come and go;
(4) in an arena or an auditorium during a sports event;
(5) in a factory with heavy machinery (ask permission to visit this area);
(6) near a piece of heavy construction equipment if the foreman says it is allright;
(7) on the schoolyard at recess time;
(8) in the school boiler-room when the furnace and other machinery are in operation.

List the sounds that are louder than the sound made by the gasoline-powered mower.

DIGGING DEEPER:

Where were sounds that were louder than the power mower found?

In which areas did sound pollution occur?

What techniques, similar to those used in other activities, should be followed when testing these areas for noise?

What other places could be investigated for sound pollution?

In which other ways might sound pollution affect people other than hurting their ears?

BRANCHING OUT:

Try to find out which cities have bylaws regulating the loudness of radios, t.v.sets, and record players after 11:00 p. m.; car hornblowing; riding motorcycles during sleeping hours.

NASHVILLE PIONEERS AND INDIANS - 45 minutes each.

One Session.
(Can be extended to two sessions if there is a particular area of interest within walking distance of school: cemetery, fort, spring.)
May choose one or both.

CONCEPTS:

Indians and pioneers had different concepts in the use of land and natural resources. Both Indians and pioneers made use of what natural resources they had.

OBJECTIVES:

To show the tools of the pioneers and how they worked. To discuss the natural material that was available for use. To gain an understanding of what the early days were like here in comparison with the present.

VOCABULARY:

sulphur lick
mound builders
flat boat
Cherokee
Chickasaws
pioneer
artifacts
trappers

THREE SHORT ACTIVITIES BY STAFF - 15 minutes each:

1. Demonstration of tools the pioneers used; maul, draw knife, broad axe, froa, adiz, wool carder, etc.
2. Signs arranged on site. Game sheets used as individual activity to match material and uses.
3. History of school community--exploratory walk--type of houses, materials used--type of soil and land use by Indians--different ways pioneer used lands compared to Indians.

FOLLOW-UP BY TEACHER:

1. Build dioramas of pioneer and Indian life--use Lets Be Settlers With Daniel Boone as source of ideas. Also build small temple mound village with natural materials.
2. Discuss the two sheets entitled "Foods the Indians Gave the World." Try preparing some common foods as pioneers did--persimmon or acorn bread, hoe cake, hackberries for meat flavoring, etc.
3. Build a flatboat like the one the Donaldson party used (instruction sheet enclosed.) .
4. How to "dye" like an Indian or pioneer--use easily available materials (black walnut hulls, sumac berries, dandelion flowers, tea). Follow instructions in Crafts Section of Unit.

RELATED ACTIVITIES:

Language Arts

1. Discuss fact that Indians had several names to identify each person--also every Indian had a secret name given to him at birth by his parents. The Indians were superstitious and believed that if you told your secret name the evil spirits would get it. So no one was allowed to use it.

They also had personal names that told something about their personalities. Girls were usually named for flowers or trees. For instance, why would one girl be called "Little Willow" and another "Clinging Vine"? Or one, "Moon Lily" and another, "Prickly Rose"? Boys were almost always called after birds or animals. Can you tell something about the personality of the boys by these names: Soaring Hawk, Little Owl, Blue Jay, Buzzard? Which boy was admired the most? Have children pick a name for themselves and write the reasons why this fits them. Many times names were picked for unusual happenings; have children pick a name that would tell something they experienced. Examples: Turnip Speed, Stumped-His-Toe, Always Tardy, First-in-Line, etc.

2. Using geography of school site describe imaginary meeting between Indians and pioneers.

Math

1. Find out the dimensions of a log cabin. Measure ones in Sevier Park or get measurements of one at Fort Nashborough. Find out how much of your classroom this would take up. Were they crowded? Comfortable? Is this more or less room than we have to live in today?

Art

Check Craft pages enclosed for instructions on tie dye, sand painting, painting with rocks, painting with natural materials.

RESOURCE MATERIALS

FROM SCHOOL LIBRARY:

Early History of Nashville, by Elliot

FROM ENVIRONMENTAL CENTER:

A Short History of Davidson County
Lets Be Early Settlers with Daniel Boone, by Peggy Parish
Collect, Print and Paint from Nature, by Frankel
How to Paint with Natural Earths and Sands, by La Renna Hess
American Indians, Yesterday and Today, by Grant

Free for the Eating, by Angier
The Art of the North American Indian, by Glubok
Bread and Butter Indian, by Anne Colver
The Art of American Indian Cooking
The First Comers, by Alice Marriott
The Cemetery as a Social Document
American Heritage Book of Indians
Various Dittos of Indian Housing, Tools, and Art
"Edible Foods," "Wild Foods," Park Interpretive Bulletins
Wild, Edible Foods, Bulletin #76
Various Indian Game, Arts, and Craft Books

The Historical Society of Nashville will display materials and give lectures on the early pioneers of Nashville.

FILMS
FROM THE MATERIALS CENTER:

Kentucky Pioneers - T404

Pioneer Journey Across the Appalachians - T77
Nashville Plus - TC 752
Colonial Life and Crafts - TC 511
Daniel Boone - T 480
Colonial Children - T 29
Colonial Expansion - T 608
Woodland Indians - TC 306

FLATBOAT:

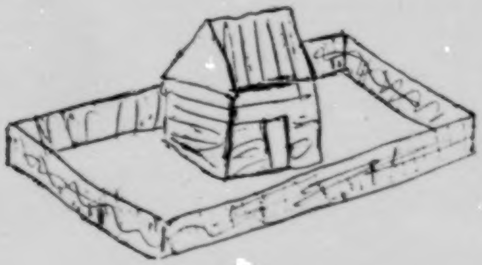
As the land became crowded along the eastern coast people began to seek new lands farther west. Some of the early settlers traveled by water. They built flatboats and loaded all their things on them. They floated the flatboats downstream on a river.

The settlers made their boats as comfortable as they could. Sometimes they lived on them for as much as a year while they cleared land and built a cabin.

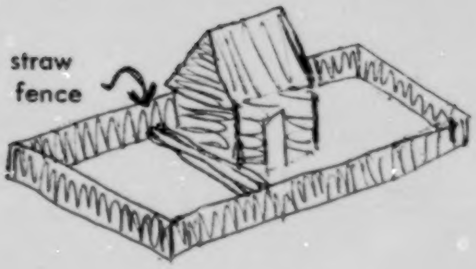
The back half of the flatboat was fenced off and used as a yard for the animals. The front half was used as a yard for the family.

You can make a model of a flatboat with the top of a box. A shoebox does nicely.

1. Make a small log cabin. Glue it in place across the center of the boxtop.



2. Make a fence of soda straws from the cabin to the edge of the boat.



INDIAN CRAFTS, IDEAS

PAINTING WITH ROCKS:

Find rocks with iron oxide--oranges, reds, yellow. Break up with hammer first on paper or cardboard. Pour into pestle, on the mortar to grind it down to powder.

Mix this with oil to make a paint. Use as with any. If paint seems to flake off the paper, add a little gum arabic to the paint.

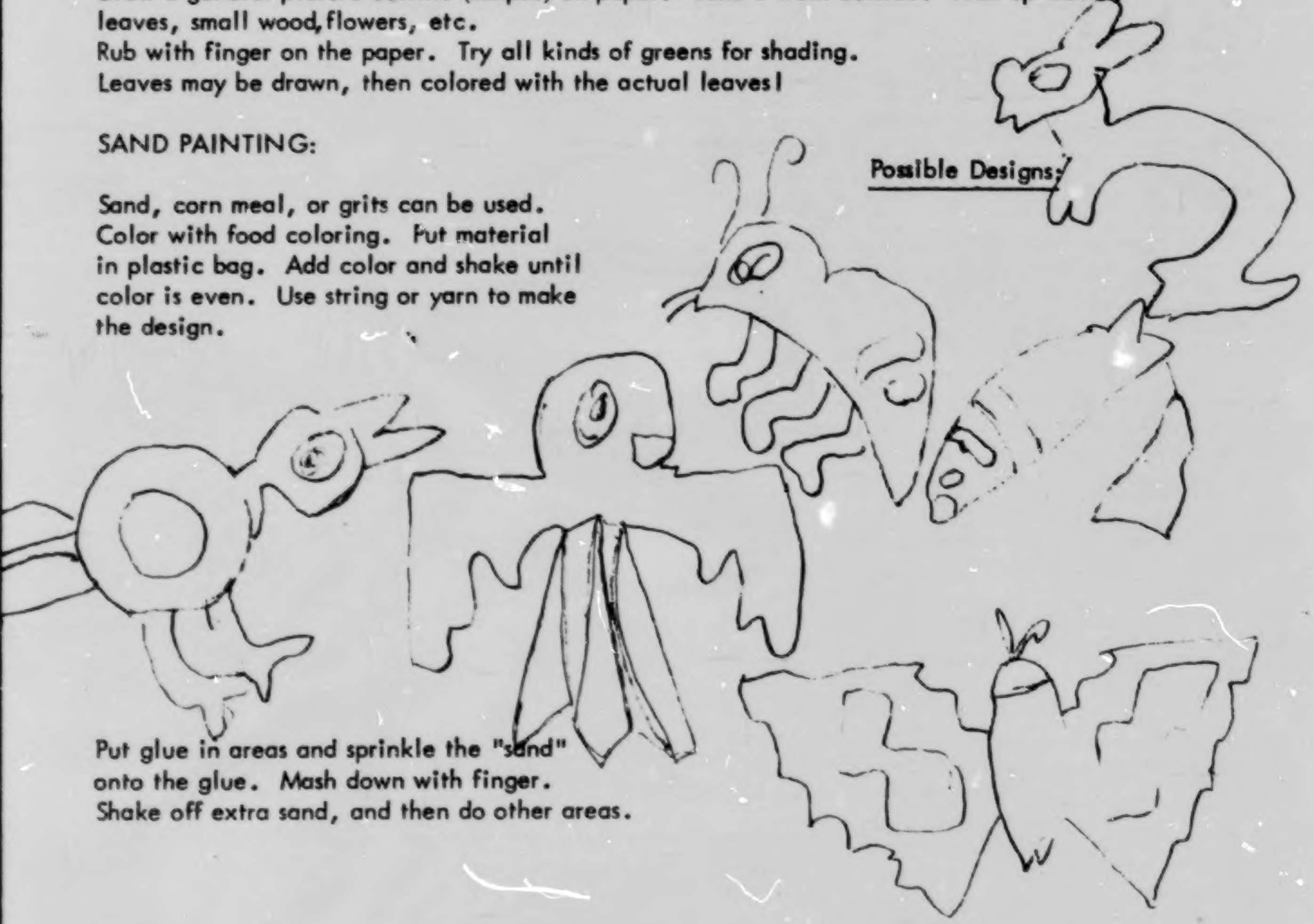
PAINTING WITH NATURAL THINGS:

Draw a general picture outline (simple) on paper. Take a walk outside. Pick up weeds, leaves, small wood, flowers, etc.
Rub with finger on the paper. Try all kinds of greens for shading.
Leaves may be drawn, then colored with the actual leaves!

SAND PAINTING:

Sand, corn meal, or grits can be used. Color with food coloring. Put material in plastic bag. Add color and shake until color is even. Use string or yarn to make the design.

Possible Designs:



Put glue in areas and sprinkle the "sand" onto the glue. Mash down with finger. Shake off extra sand, and then do other areas.

INDIAN RELICS

The American Indians, before the coming of the white man, were Stone Age people. Theirs was a hand culture, employing tools of stone, bone, shell and wood. Certain tribes used copper found near Lake Superior and elsewhere, but no Indian had learned to use metals like bronze and iron. Others had learned to weave and make baskets or clothing out of plant materials. Most tribes made pottery: moulding and baking vessels of clay tempered with sand, powdered rock or shell; some crude; some very good. They had learned to farm and had domesticated many useful plants such as corn, beans, squash and tobacco; but they had not discovered the wheel nor the plow, and the dog was their only domestic animal. Some tribes, like the Sioux of the Great Plains, were wandering hunters depending upon the buffalo for food and clothing.

In the making of weapons, tools, and ornaments, the Indians were remarkably ingenious, skillful, and patient. They discovered that brittle stone like flint or chert which had no "grain" or planes along which it would split, could be cracked with a cobblestone hammer into flat pieces or slivers. Then these could be flaked off into desired shapes, with sharp edges or saw teeth if needed. They discovered that such stone worked better when freshly dug, so they buried what was not immediately used to keep it "green". From creek beds and lake shores, from rock ledges and caves, or from limestone beds which they quarried, using cobblestones as hammers and the antlers of deer or elk as picks, the Indians obtained chunks of flint. These were fashioned into arrowheads, spearheads, knives, scrapers, chisels, and drills, using tools of stone, bone, wood, and leather.

Tomahawks, axes, mauls, celts (chisels), gouges for shaping wood, and mortars with pestles for grinding corn, acorns, and seeds, were usually made from cobblestones of granite or similar material having the proper density and toughness. These were roughly shaped by knocking off spalls with a stone hammer. The final shape was obtained by pecking over the entire surface with smaller tools. Finally, the tool marks were ground away with a gritty rock like sandstone, and the surface polished with a softer fine-grained stone.

Pebbles were grooved for weights on fishing nets; or chipped, ground, polished, and drilled to serve as ornaments. Smoking pipes were sculptured from stone, or moulded out of clay and baked. Antlers and other bones were used for picks, mallets, scrapers, drills, awls, needles, and fishhooks. Shells were used for hoes, to scrape wood or hides, to scale fish, and to make beads for ornament. Porcupine quills were used lavishly to ornament ceremonial garments, pipe stems, arm bands, and pouches.

Bows, arrow shafts, war clubs and throwing sticks were made of wood; as were their drums. Many implements, and boats or "dugouts", were made of wood. The graceful canoe had a light framework of wood covered with skins or birch bark. Root and bark fibers were used for baskets, weaving, and fish nets. Deer sinews were used for thread and lashings. Almost every plant had some use, such as for food, medicine, dye, clothing, shelter, utensils, or implements.

The articles they made of wood, bark, leather, and other plant and animal materials, have decayed and disappeared. Only their tools of stone and fragments of pottery--called "artifacts"--remain. Nothing brings home the reality of these original Americans more vividly than to find a specimen or a fragment of their handiwork.

'Twas a simpler life, and perhaps a happier one.

With bark, nuts, onions, leaves, flowers, and other plant materials, you can make many dyes of pleasing colors.

Think how dull life would be if our clothes and all things made of cloth that we use were the same drab color. They would be, if it were not for dyes. From the beginning of history, people have looked for things near at hand that could be used to give pleasing colors to fabrics.

When explorers came to the New World, they found American Indians using berries, bark, roots, and nuts to make dyes. In the same way, you can make dyes of different colors from plants in your yard, or from fruits and vegetables in your kitchen, and find out how the dyes work on different kinds of fabric.

Equipment You Will Need:

Since you have to boil the plants and other materials to get the color out of them, you will need a small saucepan. This pan should be glass or enamelware, because metal may cause the wrong kind of chemical reaction. For fabrics to test the dyes on, you might try cotton, silk, and wool. You can get a piece of white cotton from an old sheet, and pieces of white silk and wool should not be hard to find. You can use thread or yarn made of these materials instead of fabric.

You will need a few chemicals to make a mordant. "Mordant" comes from a Latin word that means "to bite." The substance helps the dye "bite" into the cloth and so makes the dye fast. That is, it stops most of the dye from running out when the cloth is washed.

A common mordant is aluminum hydroxide, made by putting powdered alum and ammonia in some water. You can get a few ounces of powdered alum at a drug store, and you probably have household ammonia in the kitchen.

Making and Using Your Dyes:

You can gather nuts, bark, or berries, as the Indians did, or you can use colorful flowers from your garden. Remember that you will need a lot of blossoms to make a small amount of dye. Marigolds, coreopsis, dahlias, are all good. Fruits such as red grapes and blueberries make good dyes. Or you might try vegetables, such as onions or carrots, or leaves that are all the same color. While it is best to make only one dye at a time, you can speed things up by soaking a second batch of chopped or mashed material in water while you work with another dye.

Suppose you are going to begin with the skins of either Spanish or red onions, which are easy to get anywhere. Slip the brownish, outer skins off several onions and chop the skins as finely as possible. Dump them in the saucepan, barely cover them with water, and put them on the stove to boil slowly for 15 or 20 minutes. If you have to add water to replace what boils away, try not to add too much. The more water you add, the weaker your dye will be.

When cooking time is up, pour the dye through a strainer into a glass bowl to get rid of the bits and pieces of onion skin. Then pour the dye back into the saucepan. Now you are ready to dye a small piece of wool cloth; a square of about three inches will do. Place the cloth in the dye and put the pan back on the stove. Boil the dye for 15 minutes, stirring with a stick to spread the color evenly through the cloth. Then take the cloth out of the dye and spread it on a paper towel to dry.

Dye squares of silk and cotton in the same way. Which fabric is colored most by the dye? Cotton is a vegetable fiber, because it comes from a plant. Silk comes from the silkworm and wool from a sheep's hair, so both are animal fibers. Do you think that animal fibers or vegetable fibers are easier to color with dyes made from plants?

Making and Using the Mordant:

To make the mordant, put half a teaspoonful of powdered alum into a glass jar and stir in one measuring cup (8 ounces) of water. Now add a teaspoonful of clear household ammonia, which will make the water cloudy. (Ammonia is strong-smelling stuff, so keep it away from your nose and eyes.) Soon the ammonia and the alum combine into a jelly-like substance: aluminum hydroxide.

If you soak an undyed square of cloth in this mixture, some of the gel gets trapped in the fibers of the cloth. When you dye the cloth, the dye will be trapped in the gel. Soak a sample of each kind of cloth in the mordant, and let it dry. Then dye each sample. Compare these samples with the samples you dyed without using mordant. Does the mordant have the same effect on the colors of all three kinds of cloth?

You may want to test your dyes to see how color-fast they are (see chart). Expose a small patch of each dyed cloth to strong sunlight for a day or so. What happens? Another test for color-fastness is washing your sample in tap water, and in soapy water. This may set some dyes more firmly, but it will fade others, especially if the water is very hot. Does using a mordant make the dye equally color-fast in all of the fabrics?

Different mordants give different shades, or sometimes even different colors, even though you use the same dye and fabric. Another common mordant is tannic acid, which you can get from tea leaves or from the bark of certain trees, as the Indians did. Make a strong tea solution by letting three tea bags soak in a cup of boiling water, or boil in water the bark from some dead twigs of oak, hickory, or sumac. Try soaking squares of cloth in this mordant and letting them dry before you dye them. How do they compare in color with the samples that were soaked in aluminum hydroxide mordant before they were dyed? Can you think of any other common substances that might act as a mordant? Try them and see.

Vegetable dyes are still in use, but today most commercial dyes are made of chemicals that are found in a sticky, black, coal tar. You might buy a packet of a coal-tar dye called RIT in a drugstore, and try it out on different fabrics. Is it more color-fast than your vegetable dyes?

See how many different colors of dye you can make from plants, flowers, fruits, and vegetables. That's how the Indians learned to dye.

Investigation:

Many fabrics in common use today are woven of manmade fibers. Rayon fibers, for example, are made of a chemical obtained from wood. Fibers such as nylon are called synthetic fibers, because they are made by synthesizing, or combining, chemicals obtained from coal, oil, and natural gas. Does rayon fabric dye more like a vegetable fiber or an animal fiber? How about nylon?

A chart like this will help you compare the effects of a dye, mordant, and color-fast test on different fabrics.

When the sample is dry, cut off a small square and attach it with sticky tape in the proper space on the chart.

SOURCE OF DYE:
Spanish Onion Skins

TYPE OF MORDANT:
Aluminum Hydroxide

TYPE OF FABRIC	UNDYED FABRIC	DYED WITHOUT MORDANT	After Exposure To Bright Sun	After Washing In Hot Water	DYED WITH MORDANT	After Exposure To Bright Sunlight	After Washing In Hot Water
Cotton							
Wool							
Silk							

INDIAN DYES

Whatever the American Indian wore, carried, or used at council meetings, ceremonies, and sacred rites, was decorated: headdresses, waistcloths, robes, leggings, moccasins, armbands, anklets, knife sheaths, arrow guivers, warclub handles, pouches, the drums--even the long stems of ceremonial pipes. The materials, designs and colors varied with the tribe or nation. Within the tribe they varied with the clan, rank, and prowess of the individual; as well as with the ingenuity and industry of his squaw.

Porcupine quills were lavishly used, even in many regions far removed from the habitat of that animal; also bird quills, long hair from the tails or hides of animals, claws, teeth, beads, and especially, feathers. Most of these were dyed in various colors to produce symbolic designs. In regions such as our Southwest and among the "woodland" Indians east of the Mississippi, where pottery was made and there was weaving of baskets or cloth, such articles also were decorated with designs in color. Long expeditions were made to obtain certain materials, directly or by trading, including materials for dyes.

Nowadays, except for ceremonial and sacred objects, Indians use commercial dyes. While the range of colors obtainable from native materials was not as great, the colors were softer and generally more permanent. Red and yellows, including orange, browns, and blacks, were obtainable in any region. Until the white man came, however, blues and greens were unknown among some of the tribes that roamed the Great Plains. The Ojibwa made a pale blue dye from larkspur flowers, and another blue from blueberries; the Chippewa and other tribes boiled very old rotten wood of maple trees, with a little sandstone dust added, to get blue and purple; some far-western tribes got blues from certain earths; a few manufactured green dyes from algae in stagnant pools, or from leaves of the snowberry, or from the twigs and leaves of an arbor vitae. An idea of how the materials employed and the colors produced--always by women--varied with the territory and the culture of each tribe, may be had by comparing the Indians of the northern prairies with the Forest Potawatomi of Wisconsin and Illinois.

The Sioux made red from the buffalo berry and the squaw currant, with the roots of prairies dock added to strengthen and "set" the color; brownish-black from green hickory nuts or walnuts; a superior black from wild grapes; yellow from sunflowers and yellow cornflowers. Their enemies, the Blackfeet, obtained a beautiful yellow from a moss that grew among the fir trees in the Rocky Mountains; a rich red from the roots of bedstraw or wild madder; black from alder bark; and a beautiful shiny black (when rubbed with bear fat) from a chocolate-colored stone which, burned and powdered, was boiled with hazelnut bark.

CONSERVATION

If particular environmental problem needs correction ....

CONCEPTS:

1. To help children understand that conservation includes prevention of waste of natural resources.
2. The most common cause for deterioration of soil productivity is the loss of the topsoil through erosion.

VOCABULARY:

conservation
erosion
natural resources
topsoil
subsoil
parent-material

ACTIVITIES:

Staff will explore school grounds with pupils and help direct them in examining and finding possible conservation problems.

1. Locate various places on the school grounds where erosion is evident. Discuss what caused it. Use technical advisors (soil technicians, county agents, foresters), to help in correcting this problem. Let the children do the work.
2. Locate various places on the school grounds where a beautification project may add considerably to the appearance of the school grounds. Let children decide, with advice from trained technicians, what method to employ in improving these places.
3. Construct bird feeders and bird baths as a means of attracting birds to your school grounds.
4. Where there is wooded land, pile brush to make a suitable habitat for small animals that may live in the area.
5. Contact the forestry, soil conservation, and Tennessee Game and Fish Commission for suggestions and help in starting projects for your school.

RESOURCES:

1. Department of Forestry
2. State Department of Conservation
3. Tennessee Fish and Game Commission
4. Environment Science Department, Metro schools.

WASTE AND LITTER POLLUTION

One Session - 45 minutes.

CONCEPTS:
Man-made things that threaten our existence are the concern of all people. People can improve their environment if they really want improvement.

OBJECTIVES:
Each and everyone of us must be willing to help solve problems. To apply problem-solving skills in both individual and group effort.

VOCABULARY:

litter	waste	packaging
landfill	recycle	biodegradable

ACTIVITY WITH STAFF:
Materials: Paper bag, chart, pencil.
Explore the school site in groups of three; each group take a different area. If there are some very bad spots near the school, these should be included. Check fence, brush areas; use problem-solving for particular area. Record types of trash (paper, food, animal litter).
Ask:

1. Why is there more litter in this area than in others (discuss wind direction, use of area, etc.).
2. What could we do here to help?
3. If we pick up the trash, will this solve the problem?
4. Would a container in the corner help? How about a poster to remind others to help?
5. If area is near school, suggest getting help from City Beautiful.
6. What can we do with the trash we've collected?
7. Should it be burned? What kind of pollution does this cause?
8. If we put it in the dumpster, what happens to it?
9. Could any of it be used over again?
10. Could we use any of it?
11. What group of people caused most of this trash? How old do you think they were?
12. If it costs the taxpayer 35¢ for each piece of litter picked up, how much tax money did you save your parents today?
13. Why do we worry about wastes?
14. Where can we put wastes that won't bother people?
15. Why not just dump it, bury it, burn it, use it in a landfill, let the garbage man worry about it? (Be sure to discuss rat and germ problems.)
16. Do you think the Cumberland River looks the same now as it did in pioneer times? Could it look that way again? Discuss.

FOLLOW-UP IN CLASS:

1. Have children make a "litter monster" or find and label large cans to put in problem areas around school. Do a Before and After chart to see the success of this.

2. Make posters to place in problem areas.

3. Set up a "litter patrol" on a regular basis.

4. Write Public Health Department for booklet, "Solid Waste Management," to find out how Nashville tries to solve its problems.

5. Discuss unnecessary waste; check contents of waste can in room to see how many sheets of paper, pencils, etc., still could have been used. In a year's time, would this save you money?

If there is time, have children walk with a magnet on a string close to the ground and see if they can pick up any "space dust" pollution. Discuss meteors and meteorites. Discuss what were most common types of litter found. Check school itself for litter areas. Also check at home as well as to and from school;in comparing lists, can you find reasons why these areas collect more litter than others?

RELATED SUBJECTS:

Language Arts

1. Write letters to the Conservation Department, Public Health, Rat Control, City Beautiful--about your particular problem.

2. Slogans, poems, riddles, to draw people's attention to problem areas.

3. Read story of Pandora's Box; creative writing about pollution's escaping to cover the world.

Math

Collect 100 pieces of litter each, and divide by type to introduce percentages. Weigh garbage or waste cans to determine how much trash in a day, week, year.

Social Studies

1. Map school grounds showing problem areas.

2. Use graphs and charts for types of litter and garbage found.

Science

What kinds of buried garbage take longest to disappear? Collect samples of many different kinds of materials. Cut or tear four pieces of approximately the same size from each material. Take cardboard carton, line with plastic garbage bag so that it is waterproof. Place 2 or 3 inches of soil in rows in the soil; tape fourth piece to outside of box for row label. Water the soil each day to keep it moist but not soaking wet. Wait one week; remove one piece of each material; compare with label. Record information; repeat with other two samples for two weeks.

SOURCE LIST

Managing Our Environment, Oak Ridge Schools

Eco-Problems posters, Instructor

Is There a Better Way?, Environmental Education Discussion Poster Portfolio

Solid Waste Management

Tennessee Department of Public Health 37219

Trash Is Taking Over, ESC

Environmental Education Project Outreach

Nature and Science Magazine, April 1, 1968

Our Polluted Planet, Ambassador College Press

What Is The E. Q. of Your School?, Chapters 3 and 4

For Pollution Fighters Only, Chapter 7

Pollution, Chapters 1 and 2, Examining Your Environment

Posters and pictures for display

Instructor, October 1970, page 30

MATERIALS CENTER FILMS:

The Garbage Explosion - SC 609

Recycling Waste - SC 618

WATER POLLUTION

One Session - 45 minutes.

Can be used in conjuction with Science In Our World, Chapter 11
Science: Testing Ideas, Chapter 9

CONCEPTS:

1. We must have clean water in order to survive.
2. There is a limited amount of usable water which must be used and reused.

OBJECTIVES:

1. To show children that we are all polluters.
2. That each child and his family have an obligation to themselves to help.
3. To help children see what they can do to improve the water.

VOCABULARY:

filter
pesticides
evaporation
oxygen
alkali
odor
microscope
nitrate
minerals
turbidity
algae
larvae
specimens
phosphate
aquatic
aerate
silt
leech
biodegradable
biosphere
sewage
acid
thermal
P.H.factor

PRE ACTIVITY BY CLASSROOM TEACHER:

1. Have children set out small jars of tap water in several locations around the school site.
2. Collect several water samples from the creek, ditch, or puddle, and leave them in the room with good light.
3. Give water IQ quiz and answer sheet.
4. Discovering the existence of water pollution:

To dramatize how the great volume of water in the biosphere compares with the small amount suitable for drinking, show the class an apple and ask that they imagine it is the earth.

Cut the apple into quarters and show the class one quarter. Tell them it represents the land area of earth; two quarters represent the oceans of the world; and the remaining quarter represents the water that is left. How much of this water is suitable for drinking? Could we get drinking water from ditches?

Pare off another thin slice. Could we get drinking water from marshes or salt lakes? Continue the cutting and questions until only a sliver is left. Hold it up. There is really just about this much drinking water in the world. EAT THE SLIVER. What would happen to us if it all disappeared this fast? How long can we live without water? (About three days.)

ACTIVITY WITH STAFF:

Materials: funnel, charcoal, filters, jars for collecting water, test kit, microscopes, lime, tablets of alka seltzer.

First check stream for algae by filtering sample. Save the filter for microscope study. After it dries, check it for color. Discuss what overabundance of algae means (pollution by nitrates).

Check the water sample for turbidity. Try filtering it again with a clean filter and charcoal. Take another sample from the water and compare. What did the charcoal do?

QUESTIONS:

1. Is this visual pollution?
2. What other visual pollution can you see? (paper, cans, trash)
3. Does your nose tell you anything about water pollution? Does clean water smell?
4. Even though we cannot drink this water, can other living things still use it? Do you see any sign of life in the stream?

The type of life found in the mud of a stream can often tell you if the bottom is polluted. If you find mayfly or black fly larvae in the water, the water is fairly clean. Worms and leeches are a good sign that the water is polluted. We will get a mud sample to take back to the room and test it for bottom life (see follow-up).

1. Can water be clean and still have polluted material in it? What else can the water have in it? Bring out the idea of dissolved minerals.
2. If salt or sugar were dissolved in this water, could you smell or see it?

Since most of the rock around here is limestone, let's find out if there are dissolved minerals in this water and in the tap water in the room. Limestone is a rock that is highly acid, so let's do a P.H. test to see if there is acid in the water. After the experiment, ask:

1. Do people need 100% pure water to drink?
2. What does this test show? Is there anything in the water you drink?
3. Are some things added at the reservoir? (chlorine, flouride)
4. Could this water be made safe to drink? How?
5. What else could be in this water that we cannot see? Would you taste this water to test it?
6. Why should you keep your hands away from your mouth after collecting samples?
7. What are bacteria? Can bacteria help or harm you?

Take a filtered sample and look at it under the microscope. Can you see anything moving?

1. What is typhoid? Cholera? Does anyone catch these diseases any more?
2. Where does this water come from? Try to trace the source of any pollutants.
3. Can rain pollute this water? How?
4. Why do people pollute water? On purpose?
5. What could you children do to clean up this water? Could neighbors help? Would they if they understood how dangerous this is? Do little children play in this water?
6. The water we are looking at could have been used by Daniel Boone or Andy Jackson. How is this true?
7. Even if people were not here would there be some pollution? Make a list of natural pollution and people pollution.
8. How does a stream purify itself?
9. Before too many people came, did this stream have an ecological balance? What is that?

FOLLOW-UP IN CLASS:

Materials: lamp, alcohol, funnel.

1. Take the sample of mud skimmed from the bottom of the water supply. Place it in a funnel and put the funnel in a glass jar containing about 3" of alcohol. Put the desk lamp in a place where it shines directly on the soil and leave the light on for 24 hours. At the end of this time, the intense heat of the light will have forced all living organisms out of the soil and into the alcohol. Use the microscope to see what is in the alcohol. Cover the remainder of the alcohol and have the children record what types of life are found , either by name or by drawing. Then repeat with mud from unpollutedstream. Compare organisms. Will they be very different?

2. Try filtering and microscopes on tap water and on water samples collected from jars on school site.

3. Check Environmental Education Manual, pages 71-82, for further activities.

4. Make a list with the children of things they can do to help, such as
    a. not leaving water faucets running or dripping.
    b. not turning water on full force.
    c. checking the house and school for dripping faucets.
    d. encouraging the parents to reuse materials, to use low-phosphate detergents or pesticides in which chemicals break down quickly, and to use limited amounts of fertilizers, etc.
    e. sharing with the rest of the family the things they have learned.

5. Put a container in the sink to measure the water waste when the children get a drink. Measure for a one-day period. Try to figure out how many people could have had their day's water supply with what is wasted (six to eight glasses per person). This could be used as a math exercise in measurement--gallons, quarts, pints.

FOLLOW-UP IN OTHER SUBJECT AREAS:

Language Arts

1. Play a game of ad-verse as an enrichment activity. The first player starts a story of water pollution in a rhymed jingle. (Example: "I saw a stream as sweet as cream." Next player: "It was clear and blue and sparkling, too." Third player: "The stream soured and algae flowered.") These jingles can be added to individual reading centers to be enjoyed.

2. Make a word chain, using the word WATER as a stringer. Take the word and see how many words go with it. (Example: water--clean--dirty--pure--muddy.)

3. Write to Tennessee Stream Pollution Control Board
620 Cordell Hull Building
Nashville, Tennessee 37219
(very good)

Math

1. Do Activity 5 under Classroom Activities.
2. Measure depth of water, rate of flow, and depth of turbidity.

Social Studies

1. Trace the source of pollutants. If a factory, how important is this to the community in the way of jobs, services, etc. Why must the factory be located in this area? Are they local?

2. Discover the history of this water. Try to figure out if it has been there a long time or has changed its path.

3. Map the stream by showing areas of worst pollution, silt, algae, etc. Introduce the concept of map symbols and keys.

SOURCE LIST

Water Fit to Use, by Carl and Bernice Carlson

Clean Air--Sparkling Water, by D. E. Shuttleworth

For Pollution Fighters Only, by M. Chester

Let's Go to Stop Water Pollution, by M. Chester

Our Polluted World, by John Perry

Object Lessons in Science, Delta Series, pages 37-50

Pamphlets--

Pollution, Examining Your Environment

Our Polluted World, AEP Unit books

Water Pollution, University of the State of New York

Stream Analysis, Environmental Science Center

Needed: Clean Water, Rex Resource Bureau

Tragedy in the Laundromat, ESC

Our Environment Battles Water Pollution, Dr. C. E. Renn

Study of Water Quality, Dr. C. E. Renn

Our Polluted Planet, Ambassador College Press

Water Wonders, Cornell Science Leaflet

Grade Teacher, October 1970

Conserving Our Waters, American Petroleum Institute

Also available: related children's books on lakes, streams, ponds, marshes, etc.

Material Kits--
CAN I DRINK THE WATER? - Ecology Kit #6
HOW FISH BREATHE - Ecology Kit #8
LIFE IN THE WATER - Ecology Kit #2
POLLUTION TEST KIT
THE WATER TEST KIT

Films--
TENNESSEE RIVER CONSERVATION AND POWER - TC 721

WATER "IQ" QUIZ

The most common substance on earth after earth itself is water. We have been using water since the day that we were born. So we should all know what water is all about. But do we? Find out how much you know by taking the Water "IQ" Quiz, below:

A. Respond to all the statements below BEFORE reading "All About Water" on the next page. Answer each question by putting a check (✓) in the proper column.

B. Do this AFTER taking the quiz: Notice the space before each of the items on the next page. Write in the space the number of the quiz question that is best answered by the information in that item. The first item has #6 already written in the space to help get you started.

Note: If you get 19-20 correct, you qualify as Water Genius; 17-18, Water Expert; 15-16, Water Whiz; 14-15, Water Bug; 13 or less, Water Melon.

	Yes	No
1. Do lakes, ponds, and streams cover 25% of the United States? -----------	☐	☐
2. Does the amount of water available to the earth remain about the same from year to year? ---	☐	☐
3. In the United States, is there more water underground than on the surface?--	☐	☐
4. Is more water used for personal reasons, such as drinking, bathing, cooking, carwashing, etc., than for any other use such as industry? ---------------	☐	☐
5. Does it take more than 300 gallons of water to produce a ton of steel? ------	☐	☐
6. Is it possible to m[illegible] water pure after it has been seriously polluted? -------	☐	☐
7. Is some water blue, some green, some brown, and some colorless? ----------	☐	☐
8. Does a cubic foot (1' x 1' x 1') of water weigh about 35 pounds? -----------	☐	☐
9. Does water expand when it freezes? ------------------------------------	☐	☐
10. Does water cover more than one-half of the earth's surface? ---------------	☐	☐
11. Is about two-thirds of the human body water? -----------------------------	☐	☐
12. Is the salt content of the oceans gradually decreasing? --------------------	☐	☐
13. Is it possible to remove the salt from sea water so that it is fit to drink? -----	☐	☐
14. Does the average man take in about one ton of water a year through the food he eats and the liquid he drinks? ----------------------------------	☐	☐
15. Is "hard water" water that has been compressed? -------------------------	☐	☐
16. Can a person live as long as 15 days without water? ----------------------	☐	☐
17. Are there any places in the United States that receive less than five inches of rain a year? ---	☐	☐
18. Is it possible for water to carry disease germs? ---------------------------	☐	☐
19. Can water that is used to make electric power be used again for any other purpose? --	☐	☐
20. Does the average person living in the United States today use the same amount of water as the average person who lived about 200 years ago? -----	☐	☐

6

______ Water that has been polluted can be returned to its original condition. When man purifies water, he uses the same basic process that nature uses, except that he speeds up the process.

______ There are several ways to remove salt from water. One of the most common methods is distillation. In this process, salt water is boiled until steam forms. When the steam cools, it returns to its water form minus the salt.

______ The weight of water varies slightly with its temperature. However, at 70° F., water weighs slightly more than 62 pounds per cubic foot.

______ Lakes, streams, and ponds occupy about 2% of the area of the United States.

______ An advantage of using water power to make electricity is that the water is returned to rivers and streams unharmed.

______ A person adrift at sea could not live more than eleven days without water.

______ The amount of water available on earth today is just about what it has always been. But, because the earth's population has greatly increased, the same amount of water must be used by more people.

______ On its way to the sea, water picks up from the earth many different minerals, including salt. The salt is deposited in the oceans. This process has been going on for millions of years. Thus, the sea becomes saltier each year.

______ Pure water is virtually colorless. However, water may appear blue, or green, or brown. Reflection of the sun's rays, reflection of the sky, and the presence of soil particles all affect the appearance of water.

______ Water covers about three-quarters of the earth's surface.

______ The amount of water used by different manufacturers to make the same product, varies. For example, to make one ton of steel,from 1,400 to 6,000 gallons of water may be used.

______ In the United States more water is used for agriculture than all other uses combined.

______ In 1900 the average person living in a town or city used about 95 gallons of water a day for all purposes. But, in today's world of washing machines, backyard swimming pools, etc., the average city dweller uses over 150 gallons of water/day.

______ The water an average man drinks, plus the water he gets from other foods, adds up to about one ton of water a year.

______ Most of the water we use comes from surface storage places. However, there is about six times as much water below the surface as there is on the surface.

______ When water freezes, it takes up more space. This is why pipes sometimes burst when the water in them freezes.

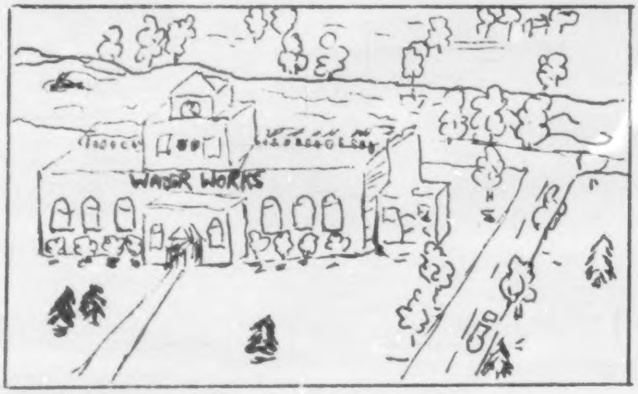
______ Disease germs such as typhoid and cholera may live in water. To kill such germs, chlorine gas is sometimes added to the water.

______ About 65% of the weight of the human body is water. Blood is mostly water, and muscles are more than 80% water.

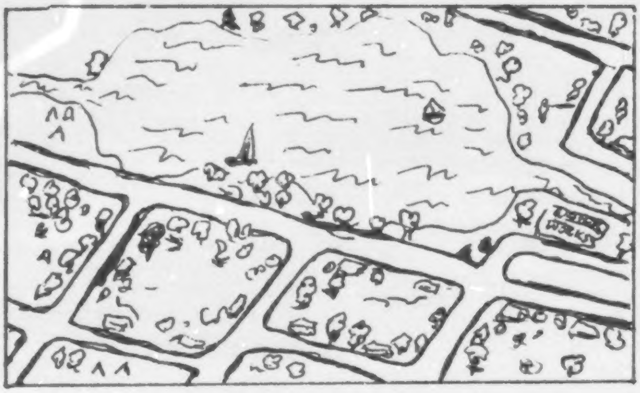
______ The average rainfall in the United States is about 30" per year. Some places receive less than 5" of rain yearly, while other places get as much as 120" of rain.

______ If water contains an excessive amount of minerals, such as lime, it is called "Hard Water."

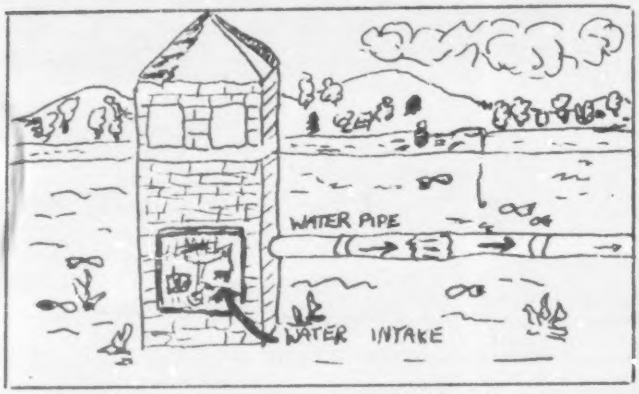
WATER FOR CITIES: FROM RIVERS AND LAKES


WATER WORKS

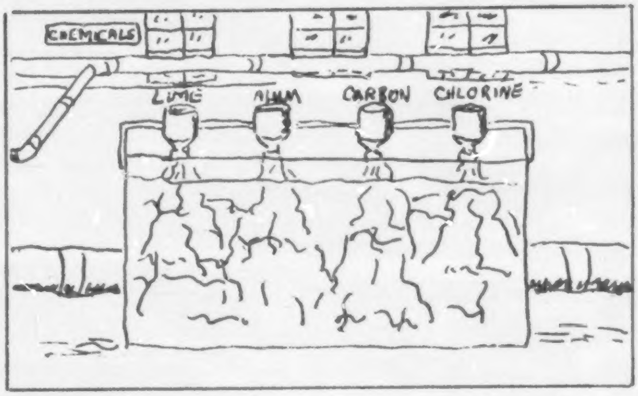
1. Some cities get their water from rivers. Trenton, N. J., obtains water from the Deleware River. St. Louis, Mo., draws water from the Mississippi River.



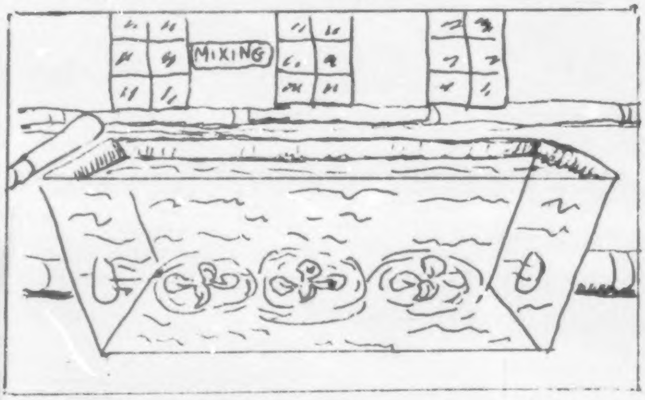
2. Other cities get water from nearby lakes. Chicago, Ill., uses Lake Michigan water. Burlington, Vt., has been drawing water from Lake Champlain for many years. In smaller communities, water is sometimes taken from wells.


WATER PIPE
WATER INTAKE

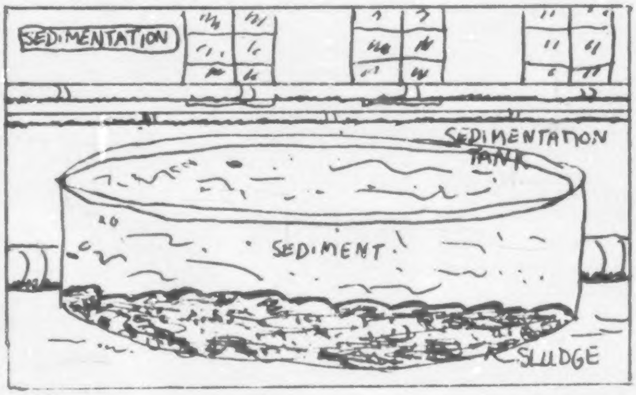
3. Water that is taken from lakes or rivers is first drawn through water intakes. A screen over the intake blocks fish, sticks, weeds, etc. From the intake, the water is pumped through a pipe to a treatment plant.


CHEMICALS
LIME
ALUM
CARBON
CHLORINE

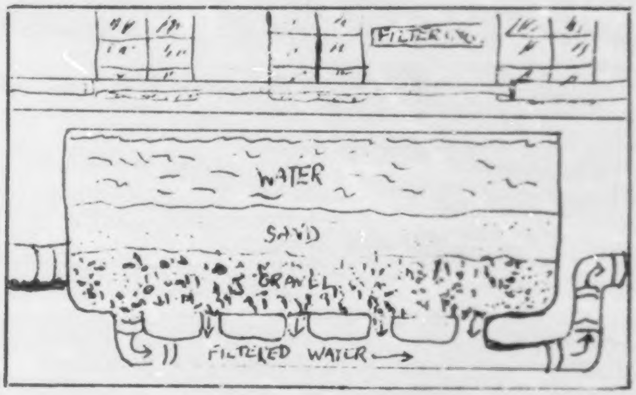
4. In the treatment plant, chemicals are added to the water to destroy harmful bacteria and to eliminate disagreeable odors. The chemicals will also help collect the impurities in the water.



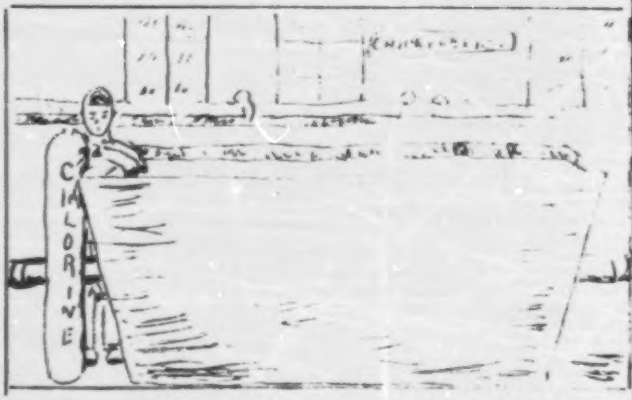
5. The chemicals are thoroughly mixed in great mixing basins.


SEDIMENTATION
SEDIMENTATION TANK
SEDIMENT
SLUDGE

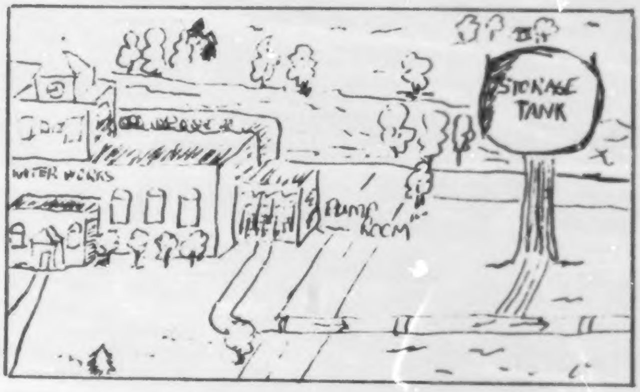
6. In the sedimentation room, bits of matter settle to the bottom of the tank. The sludge is removed from time to time.


FILTERING
WATER
SAND
GRAVEL
FILTERED WATER

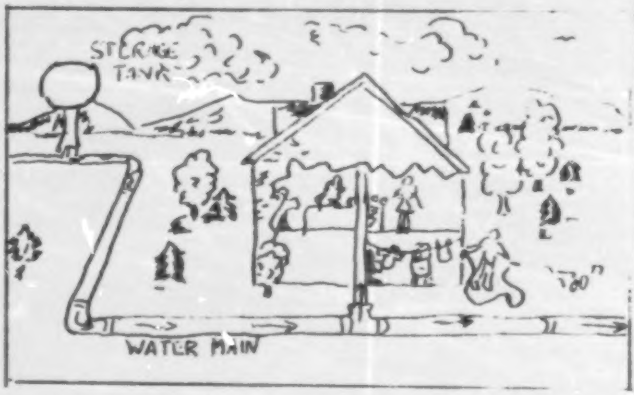
7. In the filtering tank, very fine impurities are removed as the water filters through layers of sand and gravel.



8. As a final precaution, chlorine gas is added to the water. Any harmful germs that might have lived through all the other purification steps, are killed.


STORAGE TANK
WATER WORKS
PUMP ROOM

9. The purified water may be pumped directly to users, or it may be pumped into high tanks for storage.


STORAGE TANK
WATER MAIN

10. Water under pressure fills all the large water mains, and all the smaller pipes of houses and buildings.

1. From what three sources may cities draw water? ____________________

2. What prevents large objects from entering the water intake? ____________________

3. What are three reasons why chemicals are added to the water in the purifying process? __________

4. What is the purpose of the sedimentation tank? ____________________

5. What is the final step in removing very fine particles from the water? ____________________

6. What is the purpose of the final dosage of chlorine? ____________________

7. How is the purified water sometimes stored after purification? ____________________

FISHKILL

Each year many millions of fish are killed needlessly by water pollution. Table I (see next page) tells the sad story in facts and figures. The information was gathered by the Department of the Interior's Bureau of Fisheries and Wildlife. The fishkill report warns the readers that "the annual census of fishkills cannot be considered complete. Numerous small kills resulting from pollution go unnoticed or unreported."

As you can see in Table I, the largest pollution-caused fishkill occurred in 1969. The killing took place in Lake Thanotosassa, Florida. The cause: Sewage from Plant City and factories around the Lake had been entering the Lake for fifteen years. Finally, the oxygen in the water was reduced to such a low level that fish could no longer survive.

1. The picture on the following page tells about pollution-killed fish better than words. Write your own title for the picture on the line below the picture.

2. Complete the sentences below with information from Table I:
   a. The table tells how many fish were killed over a ________-year period.
   b. In 1969, _______ states reported the number of fish killed in their states.
   c. In 1969, the total number of fish killed by water pollution was _______. In 1960, ________ were killed by pollution.
   d. In 1969, the largest fishkill at one place was ________________________.

3. Table II tells the major pollution causes of the 1969 fishkill.
   a. Notice that in the column titled "Source of Pollution," there are four major sources printed in bold type. What are the four major sources?

      ______________________________ ______________________________

      ______________________________ ______________________________

   b. Which of the four major sources caused the most fish to be killed?

      ____

   c. The word "insecticides" means "insect killers." But if insecticides drain into streams and lakes, they also become fish killers. According to the table, how many fish were killed by insecticides in 1969? ____________

4. When a fishkill is reported, explanatory remarks often accompany it. Here are four typical comments. On the line in front of each comment, write the letter of the drawing on the following page that matches the report:

_____ Leak in a pipeline allowed the fuel oil to enter stream, killing almost 2,000 fish and other aquatic life.

_____ Wastes from paper company operations entered the stream killed 1,000 fish.

_____ A derailed tank car was left overturned for three days resulting in the leakage of a large quantity of diesel fuel into the stream. About 29,000 fish died.

_____ Pesticides leaked from drums used to support a private boat dock, causing the death of at least 3,000 pounds of fish.

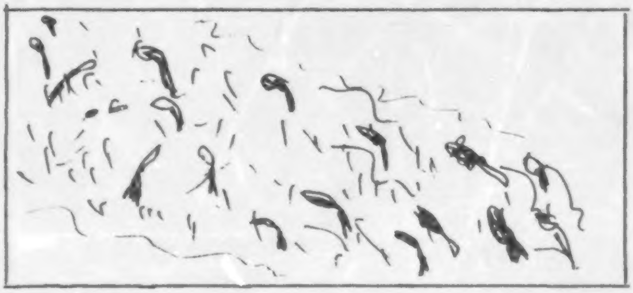
NOTE: Facts and figures on these two pages were adapted from 1969 Fishkills Caused by Pollution, Federal Water Quality Administration.

Table I
POLLUTION-CAUSED FISHKILLS, JUNE 1960 - DECEMBER 1969:

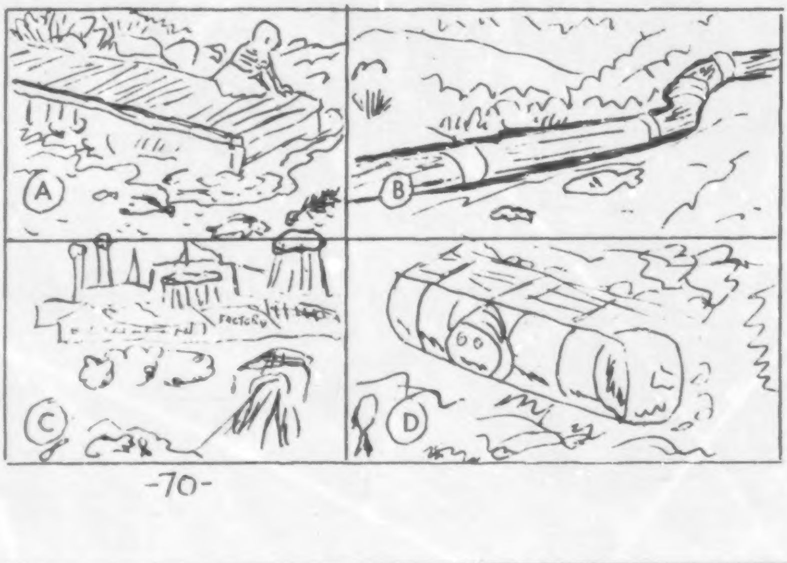
Year	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Number of States Reporting	36	45	37	38	40	44	46	40	42	45
Estimated Number of Fish Killed	6,379.000	15,910,000	7,118,000	7,860,000	18,387,000	11,784,000	9,115,000	11,591,000	15,230,000	41,004,000
Largest Kill Reported	5.000,000	5,387,000	3,100,000	2,000,000	7,882,000	3,000,000	1,000,000	6,549,000	4,029,000	20,577,000

MAJOR POLLUTION-CAUSES OF FISHKILLS, 1969:

Source of Pollution	Number of Fish	Source of Pollution	Number of Fish
AGRICULTURAL		MUNICIPAL	
Insecticides	5,982,877	Sewerage Systems	413,075
Fertilizers	73,569	Refuse Disposal	41,903
Manure-Silage	237,434	Water Systems	2,603
Drainage		Swimming Pools	850
TOTAL	6,293,880	Power	696,596
		TOTAL	1,155,027
INDUSTRIAL		TRANSPORTATION	
Mining	537,506	Rail	1,653,664
Food Products	26,711,089	Truck	56,053
Paper Products	17,977	Barge/boat	1,520
Chemicals	921,988	Pipeline	345,793
Petroleum	105,647	TOTAL	2,057,030
Metals	43,523		
Combinations	28,757		
Other	313,695		
TOTAL	28,680,182		
MISCELLANEOUS	2,450,909		
GRAND TOTAL			40,637,028



Title: ____________________



THERMAL POLLUTION

Water that is used to cool the giant machines of power plants and industry becomes very warm. When this warm water returns to its source, it mixes with the cooler water there. The effect of this mixing is to increase the temperature of the lake, stream, or river, which receives the water.

The addition of heat to natural waters to the extent that plant and animal life in the water are harmed, is called thermal pollution. Following are some of the undesirable results of thermal pollution:

Adult fish can be destroyed. As heat is added to water two things occur: (1) the oxygen content of the water is reduced; (2) with an increase in heat, fish need much more oxygen to survive. So, at a time when the fish need more oxygen, they have less chance of getting it. If the oxygen content of the water becomes too low, the fish will die of suffocation.

Fish eggs and baby fish may be destroyed. Water temperature helps determine when fish eggs will hatch. If warm water is discharged into streams too early in the year, some fish may hatch too soon. The food that the newborn fish must have may not be available. The baby fish will then die of starvation. Some fish, such as trout, may not hatch at all if the water is too warm. Other fish, such as salmon, may not even lay eggs if the water temperature isn't right.

The ability of water to destroy natural wastes is lessened. Water that has a plentiful supply of oxygen is a natural purifier of wastes that come from humans, animals, and food processing plants. The oxygen in the water combines with harmless bacteria that are also present in pure water. Together they "attack" undesirable bacteria in the wastes and make them harmless. However, if the water has been robbed of its oxygen through thermal pollution, this natural purification process cannot take place.

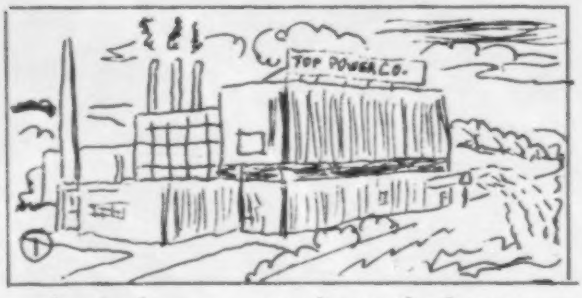
Desirable plant life in the water is harmed. Large plants are generally rooted on the bottoms of streams. These plants add oxygen to water. However, if the wastes in water are not removed, they settle to the bottom and kill these helpful plants. Meantime, smaller surface plants grow more rapidly with heat. The water surface soon becomes covered with slimy algae, and foul odors begin to rise from the water.

- -

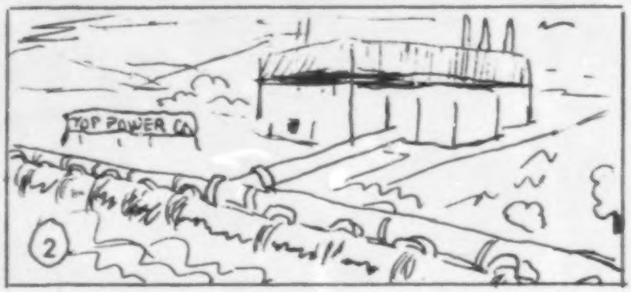
1. What happens to the temperature of streams, rivers, and lakes when hot water is discharged into them?
2. In the story, circle the definition of thermal pollution.
3. In what two ways can water that is too warm affect the hatching of fish eggs?
4. What are three kinds of wastes that can be purified by water?
5. Underline the sentence that tells how large water plants can be killed by wastes.
6. How does heat affect small surface plants?

WHAT CAN BE DONE ABOUT THERMAL POLLUTION?

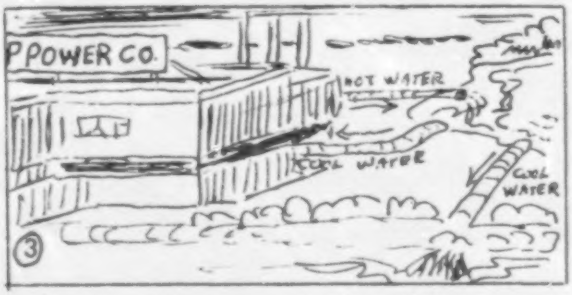
Here are some solutions to the problem of cooling water that has become warmed through use as a coolant:



1. As the warm water leaves the factory, it can be sprayed into streams. The air will act as a coolant on the water.



2. Send the warm water from the factory through many long-distance outlets. Because the water will be discharged in several places, the heat will not be concentrated in one part of the stream.



3. Store the warm water from the factories in one or more holding ponds. When the water has cooled, return it to the streams.

WATER COOLING MEETING
4

4. Improve the efficiency of water-using plants. Better equipment and processes can reduce the water needed for cooling purposes.

7. Think it through for yourself:

a. What would be an additional advantage to spraying water (No. 1 above) before returning it to the stream? ______________________________

b. How will sending water through many long distance outlets (No. 2 above) cool warm water?

____

____

c. Carefully study the pipe system shown in No. 3 above. What could be done with the water in the holding pond other than send it back to the stream after it has cooled? __________

____

d. Can you think of any other way to cool water that has been warmed through use as a coolant?

____

____

COMPASS AND MAPPING

(Compass May Be Taught Without Mapping Unit)

Two Sessions - 45 Minutes Each.

CONCEPT:

Map and compass reading skills may be used by the student for his benefit throughout his life.

BEHAVIORAL OBJECTIVES:

Students will be able to demonstrate how a magnetic Silva compass functions. They will be able to locate a geographically correct azimuth reading by using a compass and will use the mathematical ratios of their own pace to feet, to determine short distances. Students will determine an azimuth from one place to another. They will follow compass cards to various destinations using several compass bearings.

Basic techniques of map-making will be learned.

Students working in small groups are able to interact more readily with other members of their peer group. Individual students should become more willing through these activities to share ideas with the entire group. Students also will develop group methods for solving problems.

VOCABULARY:

- azimuth
- bearing
- compass
- compass housing
- contour
- degree
- destination
- direction
- distance
- grid
- landmark
- latitude
- legend
- longitude
- magnetic needle
- magnetic north
- orienting arrow
- pace
- parallel
- perimeter
- relief map
- symbols
- topographical

STAFF ACTIVITIES:

Session One--

Each student will be given a Silva compass to use. Every compass has four cardinal points. These are north, south, east, and west. The magnetic needle points to north. The metal dial is called the compass housing. The 360 degrees around the compass housing represent 360 directions one can travel from any point.

Two basic skills in using a compass are (1) finding direction, and (2) sighting a landmark (finding the degree reading for a landmark).

In finding direction, remember first to turn the compass housing until the direction in degrees is in line with the direction of travel arrow. Then, while holding the compass level and the direction of travel arrow straight ahead, the body is turned slowly around until the magnetic needle points to N, directly over the orienting arrow. The person will be facing in the direction of destination.

In finding the degree reading for a landmark, point the direction of travel arrow toward the landmark, then turn the compass housing until the needle points to N directly over the orienting arrow. The degree reading for the landmark is in line with the direction of travel arrow. Reminder: Don't use the compass near metal objects. The metal attracts the magnetic needle and throws it off.

Each student will use his compass and practice finding direction by participating in a compass game. This game has 20 markers placed five feet apart. The students will be given cards with directions to follow depending on what number of marker is theirs. Each will read three azimuths and pace off three different distances in feet. When done correctly, the student arrives at a correct destination or marker number. Each staff member will have the correct answer for the student. Correct methods of estimating distance by pacing will be taught before the student begins the compass game.

Session Two (Mapping)

There will be a discussion of drawing to scale: Types of maps, map symbols, legends, and map terminology.

Students will draw a map of a small area of the school grounds, using the above skills. Should there be an erosion problem nearby, this area will be carefully studied and plotted.

QUESTIONS:
(To be answered during the activity as an aid to learning by the students.)

1. What is a compass?
2. What are the cardinal points of a compass?
3. What is the compass housing?
4. What is a degree?
5. How many degrees does a circle contain?
6. How could a compass be used to help somebody?
7. What is the difference between the direction of travel arrow and the orienting arrow?
8. Explain how to find direction in degrees by using the compass.
9. Explain how to find the degree reading for an object when the direction to it in degrees is unknown.
10. What is meant by pace?
11. What is a map? How can maps help us?
12. What is meant by the perimeter of a building?
13. Do you know what drawing a map "to scale" means?
14. What is a map symbol? Why are they used?
15. Name several ways that maps are used.

FOLLOW-UP ACTIVITIES
For the teacher, including ideas for individualized activities:

1. Place stakes around a tall central point, such as a flagpole or other tall post--one stake for each hour of the day and/or one stake for each 15 degrees away from north.
   a. Make compass readings for the shadow (caused by the sun) corresponding to the stakes set for each hour of the day.
   b. Make hourly readings of time for each 15 degree stake.
   c. Make compass readings for 9:00 a.m., 12:00 noon, and 3:00 p.m.
   d. Select other compass readings and determine the time when the shadow falls at these points.

2. Questions similar to these may be helpful in observing, recording, and analyzing data:
   a. Through how many degrees does the earth rotate in one hour?
   b. How do the daylight hours for winter and summer compare? (Actual observer data can be compared to data from calendars.)
   c. How can a watch be used as a compass (between 6:00 a.m. and 6:00 p.m.)? One method is to point the hour hand at the sun. Bisect the angle between the hour hand and 12. That should be south. Check standard time. Why?
   d. Have children diagram the apparent motion of the sun and determine if the earth rotates in a clockwise or counter-clockwise manner.
   e. Why do the sun, the planets, the stars, and the moon appear to move around the earth?
   f. Observe the night sky at various times of the night, both in person and using time-lapse photography pictures. Polaris, the North Star, does not appear to move. Why would this be so?
   g. What is a "winter sky?" What is a "summer sky?" Have children observe the sky at 8:00 p.m., 5:00 p.m., and at other times on a given night. Must we wait until winter to see a "winter sky?"
   h. How does the path of a planet differ from that of the stars? Continue your observations over a period of weeks or months.

3. The students can make a rough map of several of the blocks surrounding the school. Have them indicate by means of symbols the outstanding features of the area. (Are there any points of historical significance?)

4. After the students have learned how to use a compass, have them apply this knowledge in determining the directions in which the streets run in the vicinity of the school.

Lay out a neighborhood map in chalk on the playground or in lines (using heavy yarn) on grass or cinders. Check directions and indicate the street names. It is sometimes surprising to discover how many children know a street only as "the next street that way," instead of by its name.

5. Distribute topographical maps to the students. Lead them to discover the following information:

a. the map shows land forms such as swamps and hills;
b. elevation for the land is recorded in feet;
c. water bodies are depicted;
d. buildings are represented; and
e. topographic maps illustrate only a very small area or section.

ENRICHMENT ACTIVITIES:

1. Make a map of an area using different methods.
2. Mark off contour lines on a hillside and then make a contour map of the hill.
3. With a compass, determine the azimuths to landmarks within a site. Walk to them and try to return to the starting point using only the compass.
4. With a map and compass, walk to landmarks that are not visible from the starting point.

ACTIVITIES AND OBSERVATIONS:

5. Draw a treasure map. Use only landmarks and draw pictures as symbols of the landmarks. Let north be represented by going toward the top of the map, south by going toward the bottom of the map, east by going toward the right side of the map, and west by going toward the left side of the map.

Try to use a scale that is fairly accurate. All maps do not have the same scale. The scale depends upon the size of the area to be mapped and the size of the finished map. Remember: Distances on earth are shown by much shorter lengths on a map. Distances which are the same on earth are drawn equal on a map. This is true anywhere on a map. It is true in any direction.

6. Draw a map of your classroom, using graph paper. This is called a floor plan. Let each square length equal one foot. This is a scale of one-half inch equalling one foot. If the room is large, let the length of each square equal two feet. Make up some symbols for desks, doors, and windows. Be sure to take measurements of the room you are mapping and to place each landmark in its proper position.

COMPASS ACTIVITIES:

1. Construct a square:
   a. Place first marker at feet.
   b. Walk 10 steps at an azimuth of 90° and place second marker.
   c. Walk 10 steps at an azimuth of 180° and place the third marker.
   d. Walk 10 steps at 270° and place the fourth marker.
   e. Walk 10 steps at 360° and place the fifth marker.

2. Construct an equilateral triangle:
   a. Place first marker at feet.
   b. Walk 10 steps at 30° and place second marker.
   c. Walk 10 steps at 150° and place third marker.
   d. Walk 10 steps at 270° and place fourth marker.

Measure the interval between the first and fourth markers. Review directions. Discuss errors. Analyze figures as to length of sides, angles, etc. Why is there a 120° difference between each of the three azimuths, but only 60° in each of the angles of the triangle?

3. Construct a trapezoid:
   a. Place first marker at feet.
   b. Walk 10 steps at 30° and place second marker.
   c. Walk 10 steps at 75° and place third marker.
   d. Walk 17 steps at 210° and place fourth marker.
   e. Walk 7 steps at 300° and place fifth marker.

Analyze. Measure error. Discuss figures, relationship of sides, etc., as in the case of the square and triangle.

4. Construct a hexagon:
   a. Place first marker at feet.
   b. Walk 10 steps at 90° and place second marker.
   c. Walk 10 steps at 150° and place third marker.
   d. Walk 10 steps at 210° and place fourth marker.
   e. Walk 10 steps at 270° and place fifth marker.
   f. Walk 10 steps at 330° and place sixth marker.
   g. Walk 10 steps at 30° and place seventh marker.

Analyze as before.

FOLLOW-UP INDOORS:

Construct the same figures to scale on paper. Use protractors instead of magnetic compasses and the same directions given outdoors. Orient properly with a north-south line on the paper. Correlate ideas for use with team and departmental programs.

Science

1. On a day when compasses are available, discuss ways in which pioneers might have found their way without compasses. Use the compasses to test such old timer's sayings as "Moss grows thickest on the north side of trees;" "Bark and tree rings show more growth on the north and northeast sides;" "The gum that oozes from the south side of spruce trees is clear as compared with the dirty-gray gum of the north side;" and "Pine and hemlock tips usually point in an easterly direction." Can the children give any logical explanation for these plants' growing

as they do?

Encourage the children to see if they can find any other plants (compass goldenrod, prickly lettuce, prairie dock) that indicate direction. Use the opportunity to discourage the drawing of conclusions from only one or two instances. Indians could tell the north side of a slope because it was quieter (more moist and mossy), whereas the dried leaves and twigs of the south side were noisier when walked on.

Social Studies

2. No one knows who first discovered the compass. The first compass, no doubt, was simply a rock or stone containing magnetized material, commonly known as a lode-stone, which when suspended on a thong or vine would always point in the same direction. The Chinese used compasses as far back as 300 A. D. According to some authorities, Marco Polo in the year 1260, transplanted into Europe a knowledge of compasses which he had gained in Cathay.

Do further research and prepare a report on the history of the compass (for those students who are interested).

Mathematics

3. A distance that cannot be estimated by pacing--for example, the width of a stream--can be estimated in another manner. Demonstrate and explain by holding your hand over your eyes like a sunshade while you are standing on one bank of a stream (real or imaginary). Raise or lower your hand so that your line of vision at the bottom of your hand sights at the opposite bank of the stream. Then while holding your hand steady in the same position, turn at right angles and note the spot on the ground where your line of vision strikes. Step off that distance. This gives you the approximate distance across the stream.

RESOURCE MATERIALS

Map Skills Project Books I, II, and III, by David Lockhart
Curriculum Enrichment Outdoors, by John Hug
Map Skills for Today, by Eleanor Johnson
Map Skills for Today's Geography, by John Maynard
Elementary Map and Compass Instruction, by Elston Larson
Map and Compass Study, by Frank G. Patterson
Contour Mapping, Golden Valley ESC
Going Places series, by William D. Pattison

Films:

Learning About Your State from the Road Map - TC 439

Let's Make A Map - TC 300

Maps and Their Meaning - TC 415

Maps and Their Uses - T 206

Maps are Fun - T 61

Which Way is North - T 227

PLANTS AND TREES

Two Sessions - (1) 45 minutes
(2) related art activity
extra session - 30 minutes.

CONCEPT:

Plants and trees are living things upon which man is dependent for a variety of benefits which contribute to his welfare.

BEHAVIORAL OBJECTIVES:

The students should learn that plants alone are the foodmakers of the world. They should know something of this foodmaking process and the structure of plants and trees. The student should know something of how plants and trees provide many benefits for man and how they help protect our soil, water, and wildlife. The student should be able to identify some plants and trees.

VOCABULARY:

- annual ring
- anther
- board foot
- bud
- cambium
- cell
- chlorophyll
- classification system
- compound leaf
- coniferous trees
- cytoplasm
- deciduous trees
- fertilization
- heartwood
- inner bark
- leaf scar
- margin
- nucleus
- outer bark
- petiole
- photosynthesis
- pollination
- protoplasm
- roothair
- sapwood
- simple leaf
- stamen
- stigma

STAFF ACTIVITIES: (First of two sessions)

Students will examine lima beans that have been soaked overnight in water. They will be able to identify the seed coat, stored food, and the undeveloped plant.

Using hand lens, students will collect seeds and study their composition. Seed pods of several types of plants may be collected after observation. The growth and function of these seeds will be discussed. The ways that seeds travel will be discussed with possible methods chosen such as wind, water, animals, people, or other transporters.

The general characteristics of the grasses will be observed. They will look for a single-jointed stalk; long, narrow, alternate leaves, each composed of two parts: a blade and a sheath; inconspicuous flowers on a spike; and seedlike fruit. Some examples are corn, Kentucky bluegrass, rice, wheat, barley, oats, and rye. Built into the observation and discussion will be ideas on conservation of the soil, food chains, and adaptation to different environments. Pollination and various parts will be covered.

The succession of plants will be pointed out and the contributions weeds make will be discussed. Some of these include food for birds and holders and builders of soil.

The value and contribution of wild flowers will be introduced. Indiscriminate picking robs a plant of its opportunity to produce seeds and removal of leaves takes "food factories" away from the plant.

Certain plants may be picked for preservation by pressing and/or by other methods of preservation. Plants will be picked for identification of their parts.

STAFF ACTIVITIES: (Second of two sessions)
Students will learn how to use a 45°, 45°, 90° triangle and to measure the height of their school building and nearby trees. Other methods of measuring height will be described briefly. The importance of trees to man will be discussed and some of their differences will be pointed out during this time of measuring.

The students should discover how a tree grows and they will learn key vocabulary words associated with trees. Ecological concepts will be stressed. If a stump is available, the students will be shown how they can learn about the tree's past by examining its stump.

Bark rubbings of various trees will be made and compared. The circumference of several trees will be measured and students will learn that a tree grows wider as it grows taller. *The Master Tree Finder* by Watts will be explained and used to identify different kinds of trees. Tree clue charts will be used as an aid in this study.

QUESTIONS TO BE ANSWERED:

What is a plant?
Do all plants have flowers?
What are some important parts of all plants?
What is pollination? Why is pollination important to us?
How do seeds travel?
What causes them to grow?
Are there plants that grow without seeds?
How does a plant grow?
What causes a plant to change in the fall?
Why don't all plants die in the wintertime?
What are the largest plants? The smallest?
How are plants used?
How can you measure the height of an object when you can't reach the top of it?
Does a tree grow from the bottom up or does it grow from the top?
How does the circumference of a tree (distance around the trunk) change over a long period of time?
How may carving initials on a tree hurt it?
What can the stump of a tree tell us?
Which layer is the dead layer of the tree?
Which layer is the growing layer?
Which layer carries sap up and down the tree?
What are the rings called?
Why are trees important?

FOLLOW-UP ACTIVITIES:

1. Make a survey of a vacant lot or a portion of it to learn what kinds of plants predominate there. If there are different kinds of plants growing in different parts of the lot, what conditions contribute to this distribution of plant life? Do two or more kinds of plants grow side by side in one area? Are there other kinds of plants growing side by side in other areas of the lot? How have some of these plants made adaptations so that they can grow in the same area with other kinds of plants?

2. Divide the class into several groups of children. Have each group mark off a small plot of ground (perhaps one square foot in area) in a region where seedlings grow. Each group should count the seedlings of a certain kind (elm or maple seedlings, for example) that are growing in the plot. Have the groups mark their plots of ground and then return to them a week or two later to discover how many of the seedlings have survived.

3. An interesting project for the children is finding a number of plants of the same kind but in different stages of growth. This can provide a valuable perspective on plant development. An alternative project is observing and sketching a single plant on successive days at first, and then later, at longer intervals.

4. Have the children compare the roots of several kinds of plants that grow in the same area. Note the depth to which each kind of root penetrates the earth. How does this help to explain why several plants can live in the same area? Where does each kind of plant obtain its moisture?

5. Choose a small plant, a shrub, or a tree, on which the leaves are easily reached. Have the children cut out several circles or squares of cardboard, just large enough to make a goodsized "patch" on a leaf of the plant or tree.

Use paper clips to attach a cardboard circle or square to each of several leaves. After about four days, remove the pieces of cardboard and have the class observe the lighter colored spot on each leaf where the cardboard deprived the leaf of light. Some of the children should be asked to report on the function of leaves in producing chlorophyll and the part that light plays in this process.

6. Find the stump of a recently cut tree to study. Count the "annual rings." How old was the tree when it died? Look for wet and dry years by examining the width of each ring. Old newspaper files or local history books can be correlated to the corresponding "annual rings" of the tree.

7. Count all of the trees of each variety that can be seen in a walk around the block or along a woodland trail. A simple method of tallying can be taught in connection with this activity, and its value will be readily apparent to the children since it will be hard to remember the number of trees at the same time that other observations are being made.

8. Have the children choose some woody plant for observation throughout the school year. They should note the changes that take place in the early fall. In the late fall and winter, the changes will be slight. In the spring, observations should be made frequently as buds begin to develop. Have the children try to discover which buds will be leaves and which will be flowers. The twigs at various points on the plant should be measured regularly and their growth recorded. Do some grow faster and longer than others? Which ones?

9. Conduct a study of leaf development by bringing into the classroom several twigs from different kinds of trees on the schoolgrounds or on another outdoor site. Be sure to select these materials according to accepted conservation practices. Put the twigs in water. Then observe how the different kinds of leaves develop from buds. Have the children note whether they emerge rolled or folded, or whether they develop in other ways.

10. To give the children a science project that will help them to remember the appearance of the leaves from different trees, have them gather and prepare a collection of leaves. Placing the leaves between two sheets of waxed paper and pressing them with a warm iron can keep them in good condition indefinitely. Leaves preserved in this way make good material for a scrapbook.

ENRICHMENT IDEAS FOR STUDENTS:

1. Collect pictures or actual products containing chlorophyll, and make a bulletin board or science corner display.

2. Collect twigs and branches shaped like individual letters of the alphabet. Some trimming to make the letters more discernible is acceptable, but reshaping or combining twigs or branches should be ruled out.

3. Trace items on the school-lunch menu or foods reported eaten at children's homes, back to the plant from which it originated.

4. Make a leaf identification kit. Turn up the bottom edge of a 9" x 12" sheet of construction paper to within 1" of the top, and staple the sides to make a simple envelope. Use 3" squares of tagboard for models of the basic leaf forms and label each. Keep the leaves in the envelope.

5. Collect leaves and identify them according to shape, margin, type (simple or compound), and arrangement (on the stem).

6. Develop a way of making a survey of the different types and distributions of plants that grow in a field.

7. Record the differences in characteristics of five different kinds of coniferous or deciduous trees.

8. Find out as much as you can about a tree or shrub through the use of the five senses.

9. List uses of leaves other than food for man and animals. For example: palm leaves for roofs, fans, mats, and hats; yerba mate (a South American plant) for a beverage; tobacco for insecticides and fertilizers. The leaves of some plants, such as the Venus flytrap and pitcher plant, catch insects.

10. Use leaves as a background for dioramas where an outdoor effect is needed to give authenticity to historical scenes for social studies, recreational activities, or stage settings for creative dramatics.

CORRELATED ACTIVITIES:

Art

1. Find "lines" in the environment; e.g., circles, zig-zag, wavy, straight, and other shapes. Draw lines to show how different birds fly. Draw lines to show how branches wave in the wind. Draw lines to show how clouds move in the sky.

Find designs in sound, color, and texture. Construct collages from natural materials such as cones, pebbles, twigs, leaves, etc.

Math

2. Make a map of an area using different methods. Mark off contour lines on a hillside and then make a contour map of the hill. With a compass, determine the azimuths to landmarks within a sight. Walk to them and try to return to the starting point using only the compass. Do other activities using the compass for location of various trees and plants on the school site.

Social Studies

3. Find evidences of how man has affected the environment. Find evidences of how the natural environment has affected man. Obtain some old tools and figure out how man used them. What plants and trees were important to the pioneers?

Language Arts

4. Dramatize stories about life in the woods. Observe and describe familiar shapes, forms, designs, or figures, in objects such as gnarled wood, areas of light between tree branches, and other interesting shapes among the plants.

5. Name observations you would make if you wanted to identify a tree. Describe various signs of the seasons. Write about your favorite plant or tree. Compose a poem about pretty flowers, plants, or trees.

RESOURCE MATERIALS

Science, K-6: Booklet #3, "Living Things," Board of Education of the City of New York
Our American Trees, by Ruth Dudley
Trees--Examining Your Environment, by John C. MacBean
Living Things, by Jeanne Bendick
Nature Study Facts and Activities, by Marjorie Seymour
Object Lessons in Science, Delta Series
Living Things--Investigating Science with Children, by James R. Wailes
Plants, Animals, and Us, by Bertha Parker
Indoor and Outdoor Gardening, by Cynthia and Alvin Koehler
Nature's Bank, The Soil, by Mary Melrose
Discovering the Outdoors, (editor) Lawrence Pringle
Trees to Know, by J. E. Potzger
How and Why Wonder Book of Trees, by Paul E. Blackwood
Object Lessons in Science, Epsilon Series
Plants in Spring, by Harold Tannenbaum
1001 Answers to Questions About Trees, by Rutherford Platt
Manual of North American Trees (2 volumes), by Charles Sargent
Wonders of the Tree World, by Margaret Cosgrove
Keeping the Plants You Pick, by Laura Foster
The Story of Trees for Audubon Juniors, by Shirley Miller
Discovering Science 5, by Albert Pilty; Chapter 10, "Plants and Their Food," pages 277-305.
Science: Testing Ideas, by J. Darrell Barnard; pages 54-61.

"Seed Plants," a Wallensak teaching tape

Films--

Characteristics of Plants and Animals - Sc 607

The Flower and The Hive - Sc 19

Flowering Plants and Their Parts - Sc 379

Growth of Seeds - Sc 53

How Green Plants Make and Use Food - Sc 186

How Plants Help Us - Sc 26

USE OF THE SENSES

One Session

CONCEPT:
There are many sights and sounds outside the school building. There are also many smells and different things that can be touched and tasted. The five senses can be used to develop a new awareness and appreciation for the out-of-doors.

BEHAVIORAL OBJECTIVES:
Students will develop a new awareness of the out-of-doors through the use of the senses. They will notice various sounds, sights, smells, textures, and tastes. Students will be given opportunity to describe some of the experiences they have. This may be done orally or by writing.

VOCABULARY:

- bulky
- clammy
- temperature
- compact
- porous
- contract
- horizontal
- identify
- vertical
- lukewarm
- density
- size
- expand
- texture
- senses
- shape

STAFF ACTIVITIES:
Students will move slowly about the school grounds looking for things that often go unnoticed. Such things as cracks in sidewalks and walls, and small areas of land, will be carefully observed for ten or fifteen minutes.

Each student will use a "School Building and Ground" checklist to help in discovering "new" objects on the campus. The "Going the Next Step" suggestions may be used as activity ideas.

Various smells of bricks, soils, trees, grass, etc., will be noted and discussed. Taste tests will be made with some of the plants common to the area. (Caution will be exercised during the taste test.)

Each pupil will use his sight to compare different designs, colors, and shapes. Each student will be given an opportunity to make a comparison between two things. Students will touch and feel the bark of trees, the soil, the texture of leaves, and other materials available in nature. Each will describe differences in what he feels.

Using the senses in these ways helps children to become aware of what is around them. The students will be assisted in utilizing the information they obtain through these experiences and in putting it into perspective.

QUESTIONS TO BE ANSWERED:

How can we learn by listening? Seeing? Tasting? Smelling? Touching?
What can we do to become better listeners?
How does seeing something help you to learn about it?
Name some good smells. Name some bad ones, too.
How does your sense of taste tell you about your food?
What tastes do you enjoy? What are some you don't enjoy?
Can you describe an object by the way it feels?
How does touching an object help you to learn about it?

FOLLOW-UP ACTIVITIES FOR THE CLASSROOM TEACHER:

1. The students may work individually or in pairs. They will "explore and tally" those items which can be found in one square foot of ground. Have the students categorize or classify all items found in the square foot, regardless of whether they are manmade or natural. Names or descriptions may be used. Have students look specifically for the following types of "evidence" and record their findings:

a. Name the materials or objects found in your square foot and, if possible, tally the frequency with which they occur.

b. Is there evidence that some materials have undergone change? Describe some of the changes.

c. Is there evidence of the presence of "man" in the area? Explain the kind of evidence that would substantiate your conclusion.

d. Which objects of phenomena lend themselves to further investigation?

2. Let the group make a list of words and phrases that could be used in describing some one object--a piece of bark or a leaf, for example. Classify these words and phrases in relation to categories such as color, size, shape, and texture. Then repeat the process with other objects. Let the children discover the nature and the number of the general categories that they need in giving a good, complete description of an object.

ENRICHMENT ACTIVITIES:

1. What is your favorite color? How does that color feel? How does it taste? How does it smell? How does it sound? List things you observed from the window which are your favorite color. Go outside and take a closer look at what you have been observing and thinking about.

2. Stop for a minute and use only your nose. Breathe deeply and take notice of everything your nose senses. List the different smells you can pick out. Where do they come from? Are some smells more pleasant than others? Which ones are they? Why do you like them better?

3. Listen for a moment . . . . . what sounds do you hear? What is the source of each sound? How are these sounds similar? How are they different? Are some more pleasant than others? Which ones are they and why do you like them better?

4. What is your very favorite place in the world? Describe it using all of your senses. Try this example: Use one word for color, two words for how the place feels, three words for how it sounds, two words for how it smells, and one word for how it tastes.

Make up your own ways of describing your favorite place. Use words, sketches, anything you wish. See if some of your classmates can figure out what your favorite place is just by looking at your description of it.

SOUNDS IN OUR ENVIRONMENT

Sounds enter our ears from all directions and come from many sources. It is difficult to escape to a place where there is an absence of sounds--silence. Sounds are so common in everyday life that we take many of them for granted and "live with them." Scientists say that the intensity of noise affects the ability of our bodies to function properly.

This experience provides you with opportunity to become aware of the different sounds entering your ears and to locate their sources. Each listening experience should be about 15 minutes in length, and you should be alone while listening and making notations. This inventory can be both indoors and outdoors for comparison purposes.

INDOORS

What Produced the Sound	Sound Description	Number of Times Sound Was Heard	Was It A Loud Or Soft Sound	Pleasant Or Unpleasant

OUTDOORS

Going the Next Step

1. Using this same outline, go outside of your home at night and listen for 15 minutes. Record your findings and compare them to sounds heard outside during the daytime.

2. Do further research to learn how sounds affect the body's functioning.

3. Do some research on the topic of "noise pollution" and how it affects human beings. Identify the main source of noise pollution in your community. Make suggestions for the elimination of noises which may be harmful.

SCHOOL BUILDINGS AND GROUNDS

Even though pupils spend much of their time at school, few are aware of objects and life found on the schoolgrounds and building. This inventory can be used to help you discover and become acquainted with these things. Check off each item on the inventory as it is discovered. You can compare your findings with those of your classmates.

Evidence of Animal Life — Check

Bird nest ____
Bird ____
Squirrel nest ____
Snake hole ____
Mole hole ____
Rabbit ____
Ant hill ____
Beehives or nests ____
Wasp nests ____
Spider ____
Earthworm ____
__________ ____
__________ ____
__________ ____
__________ ____

Evidence of Plant Life — Check

Deciduous tree ____
Evergreen tree ____
Flower ____
Moss ____
Fungus ____
Lichen ____
Shrub ____
Hedge ____
Mushroom ____
Climbing vine ____
Galls ____
__________ ____
__________ ____
__________ ____
__________ ____

Miscellaneous Objects — Check

Fence ____
Recreation Equipment ____
Propertyline mrkr ____
Parking lot ____
Flagpole ____
Manholes ____
Fire hydrant ____
Bicycle rack ____
Utility pole ____
Directional sign ____
Weather instrument ____
__________ ____
__________ ____
__________ ____
__________ ____

Miscel. Objects — Check

Hill ____
Grating ____
Pond ____
Iron railing ____
Floodlights ____
Garbage can ____
Air vents ____
Fire escape stairwell ____
Utility meter ____
Historical marker ____
Culvert ____
__________ ____
__________ ____
__________ ____
__________ ____

Going the Next Step

1. Identify at least five of the objects in the above lists and do some research on them. Your discoveries about these objects may prove very interesting.

2. Name the objects in the above lists which might have a negative effect on the health and safety of children on the school grounds. Explain how children can and should be earned about the dangers they face in using or being in the vicinity of an object.

3. What types of plants would you like to have in greater abundance on your schoolground? What can your class do to increase the number of these plants on the schoolground?

4. Select an object on your schoolground, such as an anthill, lichen, flower, bud, etc., and examine it daily, recording in writing your observations of changes which occur.

FOLLOW-UP - Descriptions:

What did you see, hear, feel, smell, or taste that could be described by the following adjectives?

hard -

soft -

green -

shiny -

rough -

smooth -

red -

yellow -

tiny -

large -

shrill -

sweet -

ACTIVITIES TO SHARPEN THE CHILDREN'S SENSES:

1. Discover objects relating to texture which can be described as slick, hard, rough, soft, slimy, velvety, coarse, knobbed, ribbed, furry, hairy, waxy, etc.

2. Discover objects relating to shape which can be described as small, large, oval, round, oblong, lobed, ridged, smooth-edged, rough-edged, triangular, pointed, curved, billowy, horizontal, expansion, contraction, etc.

3. Discover objects relating to density which can be described as spongy, solid, thick, lumpy, hollow, compact, porous, non-porous, etc.

4. Discover objects relating to temperature which can be described as hot, cold, damp, clammy, moist, dry, wet, cool, lukewarm, etc.

5. Discover objects relating to size which can be described as narrow, large, small, tall, short, thick, heavy, bulky, miniature, etc.

6. Look for evidence of life "above and around water" including insects, turtles, algae and other plants, worms, frogs, etc.

7. Observe the differences in the "bark of trees." Some may be shaggy; some will look like the shapes and colors found on the backs of certain snakes; some will have wart-like projections; some will have deep ridges, etc.

RESOURCE MATERIAL

Curriculum Enrichment Outdoors, by John Hug

Discovering the Outdoors, by Lawrence Pringle

Tips and Tricks in Outdoor Education, by Malcolm Swan

Probe--Handbook for Teachers of Elementary Science, by Mary Roy

Four Seasons and Five Senses, by Ruth Radlaver

Changes, Elementary Science Study

Young Scientist Takes A Walk, by George Barr

What to Look for in Autumn, by E. L. Watson

The Sense of Wonder, by Rachel Carson

All Around You--An Environmental Study Guide, U. S. Department of Interior

An Environmental Encounter with the Community Using the Five Senses, from Phoenix Union High School System, Phoenix, Arizona

Children's Museum programs.

ANIMAL HOMES

(No live animals provided by staff.)

CONCEPTS:

Animals are born, grow to maturity, and die. Animals are dependent upon food, water, and shelter in order to live and survive. Where an animal finds food, water, and shelter, is its habitat. Some animals have backbones; some animals do not have backbones. Animals are important in the balance of nature. Animals provide man with a source of food, clothing, and enjoyment.

OBJECTIVES:

To help the student understand that animals are important and a necessary part of the environment; that animals can be found where the necessary means of survival are present (food, water, and shelter). Animals live above and below ground.

To help the student see the importance of animals and develop a responsibility in caring for their environment.

VOCABULARY:

invertebrates
vertebrates
hibernate
herbivore
metamorphosis
amphibians
carnivore
insects
adaptation
habitat
reproduction
omnivore
migration

INVESTIGATION AND ACTIVITIES BY STAFF:

A. Explore Schoolground - When exploring the schoolground, burrows and other openings are excellent signs that animals may live in the area. Many openings in the earth are used by animals. These openings range from earthworm or crayfish to mice. Mice as a rule do not dig burrows. They will sometimes use those dug by other animals, but usually seek natural openings among rocks and lots.

1. Determine the size of the opening.
2. Does the burrow have two or more entrances?
3. What other signs do you find near the burrow?
4. Does it appear to be active?
5. Is it on a hillside near the woods, or is it in a flat,open field?
6. Try to theorize what type of animal used this home. Look for signs of activity around the opening.

Animals also live above ground--

1. Look for possible habitats in the hollow of trees, exposed high in a tree, in bushes or plants near the ground.
2. What does it seem to be made of?
3. What other signs are present near the home?

B. Animal Tracks - When exploring the schoolgrounds, if any animal tracks are found, make plaster casts of them.

C. If there is a stream or creek on the schoolground, examine it for possible animal life. Look for crawfish, frog eggs, frogs, and other aquatic life. Discuss with the children why these animals prefer this environment.

D. Look under rocks, within and under rotten logs, along fence rows, and in open fields for signs of insect homes. Try to catch several insects; with a hand lens, examine them. See if children can distinguish the body parts. Compare the characteristics of these insects. How are they adapted for living in this particular environment? What source of food is there? Would they provide a source of energy for other animals?

E. Examine the shrubs and bushes on the schoolgrounds. See if the students can find any signs of animal life.

F. Dig up some soil. Try and find earthworms or other life stages of insects. Have the children give their impressions of how an earthworm is adapted to living underground. Ask them if it's possible to draw an earthworm.

G. Look for different spider webs.

FOLLOW-UP ACTIVITIES:

A. Explore a pond or stream community.
    1. Gently pick out the animals and put them into a shallow pan containing clear water.
    2. Observe the form of the animals. How do they swim or crawl?
    3. Set up a small aquarium in a pint or quart jar to take back to classroom.

B. Construct a balanced aquarium.

C. Make a trap for small animals. Place a large juice can into a hole that you have dug so that the top edge of the can is just below the surface of the soil. Small animals walking along the surface will fall into the can (snails, slugs, insects, spiders, and perhaps a small toad). Place the can in an out-of-the-way place where it will not be disturbed--under a bush, next to the wall of a building, or next to a fence. Be sure to check your trap often.

D. Make a chart and draw or paste photos to show the kinds of animals that breathe in different ways.

E. Make a chart of animals who are fast runners. Bring in a housecat and try to find out what aspects of its body make it a good runner.

F. Make a chart and show the animals that use color for protection (lizards, snakes, birds, fish, etc.).

G. Strong animals protect themselves by fighting. Their general characteristics are strong muscles, sharp teeth, and claws. Bring in pictures to show animals that protect themselves by fighting. Describe the physical features that help them to be good fighters. Demonstrate the differences in teeth, claws, and muscle structure.

H. Construct an incubator; let the children do this. Secure fertile eggs and try to hatch them.

MATERIAL NEEDS:

1. Hand lens
2. Insect book
3. Guide to identifying animal tracks
4. Small nets
5. One large net
6. Pluster

RESOURCE MATERIAL

Program on Animals, Children's Museum

Investigations in Ecology, by Beth Schultz and Phyllis Marcuccio

Discovering Nature, Educational Insights, Inc.

Objectives and Field Activities--Environmental Education, Paducah Public Schools

Living Things--Investigating Science with Children, Volume I, National Science Teacher's Association

Films--

Adaptations of Plants and Animals - Sc 181

Animal Homes - Sc 563

Animals and Their Foods - Sc 190

Animals and Their Homes - Sc 194

Animals are Different and Alike - Sc 409

Animals Useful to Man - Sc 514

Animals with Backbones - S 6

Animals without Backbones - Sc 573

AIR POLLUTION

One Session - 45 minutes.

CONCEPT:

Pollutants in the air can affect the welfare of both the individual and the community.

BEHAVIORAL OBJECTIVES:

The children will have an understanding of the source of air pollution and some ideas for solutions.

VOCABULARY:

- damage
- affect
- liquid
- combination
- complex
- welfare
- damage
- data
- necessity
- solid
- pollutants
- exhaust
- smog

PRE-STAFF-VISIT ACTIVITY:

Microscope slides will be sent to the teacher. Each should be coated with a thin layer of Vaseline. They should then be placed outside on different parts of the school site and left all day. Some might be left all night. Be sure and mark on each slide where it was placed on the site.

ACTIVITIES:

(Inside the classroom) The staff will discuss with the class what air pollution is and how it affects us. The class will be divided into three groups, each with a staff member.

Each group will do a short (10 minute) activity with a staff member and then move on to another activity. Each child will have a chance to try all of the activities.

Activity I

Using student microscopes and strong tripod lenses, the students will look at the slides from the school site. On a data sheet they will mark answers to questions: How many different kinds of materials can you see? How many of a single kind of material can you see?

Activity II

Use the teacher's car, the staff car, and other cars (with permission). Tie a damp cloth or filter over the tail pipe of the car. Start the cars and let them idle for a few minutes. Take the cloth from the tail pipe and compare the results. Discuss with questions: Which car has the darkest cloth? What is making the stain? What happens to the material that comes from the tail pipe? Is there any material that was not caught by the "filter"?

Activity III

Walk around the school site. Make a list of everything you see that could contribute to air pollution. Use this as a basis for later classroom discussion.

A microscope or several tripod lenses will be left with the teacher for future study with the slides.

QUESTIONS TO BE ANSWERED BY CLASSROOM DISCUSSION OR OUTSIDE ACTIVITIES:

1. What is air pollution?
2. How does the air become polluted?
3. Is air pollution dangerous? Why?
4. Can signs of air pollution be seen now? Where? Why?
5. Why should there be a concern about air pollution?
6. Is it necessary to develop control measures for air pollution?
7. What are some of the ways air pollution can be controlled?
8. How can students become involved with air pollution?
9. What sources of air pollution are around our school?
10. How can they be controlled?
11. What can each person who drives a car, do to help control air pollution?
12. How can pollution in the air be detected?
13. How can some of the pollution from cars be detected?
14. How are some sources of pollution trying to solve the problems?
15. How can students in the school community and in their home community help make people aware of the problems?

FOLLOW-UP ACTIVITIES FOR THE CLASSROOM TEACHER:

1. Use the ideas listed in the unit on Air Pollution in the new teacher's manual, "Using The School Site and Community as an Environmental Study Area."

2. Have the children start a campaign to inform the community about exhaust pollution and what each person can do.

   a. Use the auto checklist of exhausts and the information sheet found in the booklet, "Troublesome Tailpipes" (available from Environmental Education Department).

   b. Mimeograph the sheets and have the children distribute the sheets to teachers in the school and neighbors, with an explanation of what they are trying to do in the study.

3. Figure out how many pollutants were caused by each family car.

   a. Make a checklist of how many gallons of gas per week were used. Multiply this by 52 to get an idea of a year's use.

   b. See Page 9 of "Troublesome Tailpipes" for chart of emissions in exhaust and use of this to figure the pollutants per family per year.

4. Show how certain pollutants are invisible but can be detected by smelling them. Have the children face the front and use a spray can of air freshener, hair spray, or some other scent in the back of the room. Ask the children to raise their hands as they smell the odor. Do it where they can see to show them that the smell can be invisible. Spray a non-scented spray to show some gases cannot be detected by smell or sight.

5. Have each student bring in a list of things that his family does that could contribute to air pollution. The list might include

driving a car,
burning leaves,
using electricity (coal is used to make it),
burning oil or gas,
cooking outdoors,
using a fireplace in the house,
using hair spray,
spraying the garden, and
mowing the lawn.

Which of these activities could be eliminated? Or changed to reduce air pollution?

6. List different sources of air pollution in the school community:

Is trash burned?
Are fires started in dumpsters?
Are people burning leaves and trash?
Are trees being burned as land is cleared (newspaper clippings on this issue and methods to help the contractors with this problems can be discussed.)
Are factories with smoke and gases operating?

Can air pollution be eliminated completely? What are some natural pollutions? How did nature take care of these?

7. Figure out how much each child breathes in a day. Give each child a balloon. Have each one blow it up with the same amount of air they would take in as they breathe. Count the breaths. Figure the breaths taken each minute per child and multiply by hour-day. Figure out how many balloons of air each child breathes per day. Figure for the class. How would the amount increase if the children actively exercised? Use a wet cloth or filter and let the air in each balloon go through it. Is there any strain on the filter?

8. Using the vacuum cleaner method in the manual, take the same amount of air through the window of the classroom that would be in one of the balloons. Look at the filter to see how much pollution might be taken in, in that number of breaths.

INDIVIDUALIZED ACTIVITIES:

1. Keep a calendar of smoggy days occurring in the community. Check this with the air pollution index given each evening on the news. See if there is a relationship. Why?

2. See how weather affects air pollution. Investigate air currents.

3. Get some balloons. Blow them up and tie a postcard to each balloon asking that the finder fill in the requested information and return the card. Release the balloons from a rooftop. When the cards are returned, mark the information on a city map. Check the air currents from this and see if any factories or other polluting areas might affect the school or children's homes.

4. If plants are grown at home, find out if any have been affected by pollution.

ENRICHMENT ACTIVITIES:

(These can also be used as individual activities.)

1. Write a paper telling how a school student can help stop air pollution.

2. Make up air pollution jingles to use on handouts and on posters.

3. Prepare a "radio show" and get permission to use the school intercom for broadcast.

4. Watch for news items in papers and magazines. Cut them out and put them in a scrapbook to use as reference.

5. Make some cartoons about air pollution. Put them on the school walls or in the school paper.

6. Find out what is being done about air pollution in your community. Ask about free materials from local agencies and for a resource person to come and talk to the class.

7. Visit a car mechanic and ask him what is being done in new cars to cut down on exhaust.

8. Ask mother not to dust one piece of furniture (wood or plastic) in the house. Use a cloth with a light coating of wax and remove the material that has collected. Look at it with a lens.

Look at a car that has been standing for a few days. Wipe off an area. Compare this material with that taken from inside the house. Which pollutants are the same? Which are different?

CORRELATION WITH OTHER SUBJECTS:

Social Studies

1. Locate any factories or other sources of pollution nearby. What do they produce? Could they be relocated so as not to pollute homes? Why did they select their site? What would it involve to move them? How is their pollution affecting the neighborhood (people moving out, areas being zoned for business)? Make a survey of local people. See if they notice the pollution. What effect has it had on them (health, etc.)?

2. With permission, select several types of businesses in the school community. Write a letter explaining what the study is trying to discover. In each business, tape collection papers on walls (small squares of wax paper coated with vaseline). Put one near the floor. On another wall, put one up about 5 feet. Leave these for a week.

When taking them down, be sure and mark where they were placed and in what business. Tape on white paper and examine each one. Put the following information on a chart: In what business did you find the largest variety of materials? Which had the greatest number of materials? Which had the greatest amount of pollution? Which type might affect the health of the workers in that business? At what height was the most material collected? Would there be any possible pollutants that would not show up on the test sheets (gas in garage)?

3. Find out how air pollution in the form of smog might be dangerous. Read about the Killer Smog of London. How many deaths occurred? What was done to change the situation?

Find out about Red Alert days in Los Angeles. What are people told not to do on these days? How would this affect a school? How often might Los Angeles have such an alert? What causes it? What can be done?

4. Make a survey explaining what harm air pollution is doing in the community. Explain that in order to end or control the pollution, the production involved may be costly; and that the consumer would pay the price in added costs. Survey the community to find out how many people would be willing to pay the higher price for less air pollution.

Language Arts

1. Find out the local air pollution agency. Write a letter asking for information concerning their work.

2. Work out a debate and present it to the PTA. (Resolved: Increased costs of consumer goods will be acceptable in order to decrease air pollution.)

3. Prepare a flannel board lesson showing how air pollution is created and present it to the class. (Model available from Environmental Education Department.)

4. Keep a record for a month of an existing problem in the school community (smoke, smell, etc.), and send the report to the agency controlling air pollution.

5. Make up poems, short stories, jingles, and slogans about air pollution. Use these on posters and for walls of hallways.

6. Make small handout cards telling people what THEY can do about air pollution. With permission, hand out on street corners near the school and in the community.

7. Write a story about the difference in air quality in Nashville, 100 years ago.....20 years ago.....(worse than now because of burning coal soot).....today.

8. Mount pictures about air pollution on cardboard. Put in folder and use as a basis for creative writing.

9. Let each child make his own air pollution "dictionary." As new words are presented in class, have him add the words to his dictionary. As other types of pollution are studied, other pages can be added.

10. After a CONCEPT has been presented, have the group divide into small "buzz" sessions and report possible solutions back to the entire class.

11. Read and give a report on how air pollution is destroying statues and art works. What is being done about it? What about buildings (sandblasting)?

12. Make up a play. Characters should include businessmen, the public, health people, etc. Let each explain his "side" of the issue of air pollution.

Math

1. Use the numbers and amounts of pollutants gathered on the slides, and make a graph showing how many and what amount of each.

2. Figure out random samplings of the pollutants and put onto a chart of the school site.

3. Use the numbers and amounts of each material found on the slides and with the measurement of the slide, figure out how much might be found in a square foot and a square yard, & the schoolyard (in order to do this, the schoolyard front or back would have to be measured).

4. Check different day's air pollution index and make a graph showing the difference in the days of the week. Use another chart to show weather conditions on these days. Compare the two charts with graphs side by side in different colors. Do the same with the pollen count.

RESOURCE MATERIALS

The following materials are available from the Environmental Education Department:

Using the School Site and Community as An Environmental Study Area, New manual (for teacher to keep
The Air We Live In--Air Pollution, by Jane Marchall
Let's Go To Stop Pollution, by Michael Chester
Clean The Air, by Alfred Lewis
For Pollution Fighters Only, by Margaret Hyde
Clean Air, Sparkling Water, by Dorothy Schuttleworth

Pamphlets--

Troublesome Tail Pipes, Min., Environmental Education Department
Look Around You, First Follow Nature, Earth Is My Home, Scholastic Earth Corporation
Ranger Rick magazine, August, September, 1971
Eco-Problems Posters, Knapp
Pollution pictures, Cook Publishers
Pollution flannelgram, Milton Bradley
Environmental Education, Instructor reprint
Three Units in Environmental Education, Grade Teacher Report
Pollution, Wentworth
Our Polluted World, AEP book
Air Pollution Activities for Elementary Schools, Science Activities - March 1972

Other books not available in Environmental Education Department library:

The Unclean Air--A Meteorologist Looks at Air Pollution, by Louis Batter
Dangerous Air, by Lucy Kouler
The Long Search, Man Learns about the Nature of Air, by Harry Sootin
The Vital Air, Man's Environmental Crisis, by Thomas Aylesworth

Air and Water Pollution, by William Leinward
How to Live in Our Polluted World, by Bethel
Your Environment and What You Can Do About It, by Saltonstall

Films-- (Available from Materials Center)

Air Pollution--A First Film

Air Pollution

Free Materials--
(Available from Division of Air Pollution, Public Health Service, Department of HEW, Washington, D. C.)

Our Polluted Planet, Ambassador College Press, Pasadena, California

Easter Seal Foundation, Local TB Respiratory Association

ARTS AND CRAFTS

Time of activities will vary.

Concept - To create an awareness of the beauty of our surroundings, especially that of small, often unnoticed examples of color, symmetry and nature's art.

Objectives - To develop skills in using natural materials as an art medium.

Some activities will be limited by materials available at certain times of the year.

Activities

1. Murals made on wood plaques using natural materials.
2. Making stone bugs or pebble people. Children should have time scheduled to collect material.
3. Acorn people - acorn jewelry.
4. Collections of materials such as leaves, small rocks, insects, etc. in a white,plastic ring- especially good for bulletin board displays and room mobiles.
5. Leaf print or animal track collection on paper or cardboard.
6. Ozalid prints of plants and flowers.
7. Paper weight or plaques of animal tracks made as an imprint in plaster of paris.
8. Growing crystals - children provide jars and salt. We will furnish bluing and ammonia.
9. Various cornshuck crafts when cornshucks available.
10. Dying with natural materials - done in late spring and fall. Teacher needs to provide hot plate and # 10 cans from cafeteria.
11. Pins and pendants made of wood rounds.
12. Coloring pictures with natural materials.
13. Drawing tree shapes.

INSECTS

Concepts - Insects are animals; they require food, water, and shelter in order to live and reproduce. Insects are found in nearly every part of the world, from the Arctic and Antartic to the equator.

Insects live below ground, under rocks, on top of and below the water, in leaf litter, roots of trees, in wood (living or fallen logs), skimming the ground, on other animals, fruits, and seeds of trees. Insects can be found everywhere.

Some insects are beneficial to man, others are harmful. Insects are a part of our environment and they occupy a particular niche.

Objectives - To become acquainted with various insects and where they make their homes. To study the life cycle of two insects.
To learn what thing insects do about controlling or regulating their environment. To learn how some insects secure their food. To help the student see that insects are an important part of our environment. To learn how insects protect themselves.

Vocabulary

arthropod
abdomen
adaptation
antennae
behavior
community
exoskeleton
habitat
metamorphosis
moult
ovipositor
predator
prey
pupa
respiration
segments
social
specimen
swarming
thorax
vibrations
galls

Staff activities

1. Examine the school ground and immediate community to find places where insects make their home.

2. Collect insects using nets and insect grabbers. Use hand lens and insect viewers to observe the body structure of insects captured.

3. Use an insect killing jar to kill insects for a more indepth observation.

4. If possible, set out some bottle caps in a place where bees are flying. Place a little honey dissolved in water in each. Note what happens. Now place each cap on a circle of differently colored paper. Do bees visit one color more than other?

5. If there are wooded areas near school, look for insects in these areas. Notice how insects use camouflage as a means of protection.

6. Visit a stream, observe where insects make their home and lay their eggs.

7. Find a spider web, toss an insect into this web and notice the actions of the spider. Discuss with the children how the spider uses this web.

Questions to be answered

1. Where is the skeleton of an insect? How hard or soft is it? Is it rigid or flexible? What happens when an insect molts?

2. Wings - Who has them ? How many? How do they fold?

3. Antennae (feelers) - What are they used for? What are their shapes?

4. Do all insects have the same mouth parts?

5. How many legs do insects have.

6. How are the body parts of insects divided?

7. How do insects develop from egg through adult stage?

8. How do insects living in streams secure food?

9. How are insects a part of our environment? What influence do they have on our environment?

Follow up activities for teachers

1. Find a web without the spider in it. Spray it with a can of white enamel, held far enough away that large droplets do not collect on the strands. Place a sheet of black construction paper behind the wet web. With scissors, snip the foundation lines, blow the web against the paper to make it flat. When the paint is dry, place the web in an acetate folder to preserve it.

2. Draw and label an insect showing the three body divisions. The grasshopper is a good example to use.

3. Have children (interested) start an insect collection.

4. Under a low-power microscope, examine the mouth parts of different kinds of insects. Try to match these with the way they feed.

5. Observe ants going back and forth from their home to some food source. Take your finger and rub across their path. Notice what happens.

RESOURCE BOOKS

1. Gray, Alice. The Adventure Book of Insects
2. Ward's Natural Science Establishment, Inc. - How to make an insect collection.
3. Sadler, Doug. - Studying Insects
4. Materials Center - Various films on insects
5. Golden Guide Books on Insects.

MATHEMATICS OUTDOORS

One Session - 45 Minutes

Objectives - To offer opportunities for developing mathematical concepts and skills and to introduce the metric system.

Activities - Students will learn or will review the pace and will "step off" a given area. This activity will be done as a group. Individual projects may be assigned.

Students will learn the size of an acre. An acre contains 43,560 sq. ft. Possible sets of dimensions for pacing include: 209 ft. by 209 ft., 150 ft. by 290 ft., and 100 ft. by 436 ft. Children might stand at fifty foot intervals and outline the perimeter so that the concept of an acre will have been made clear to the students.

Liquid measure will be studied as well as dry measure. One-half pint, pint, quart, half gallon, and gallon containers will be used for comparisons. Water can be used to show actual equalities. Bushel and peck measures can be studied by using sand, dirt, or some other dry substance.

Children often find it interesting to estimate the heights of tall objects that cannot be easily measured directly - for example, trees, flagpoles, and tall buildings.

One useful method of making estimates is the "stick method." A child about five feet tall will stand at the base of the object to be measured. Then each of the other students will move back about 100 feet and hold a pencil or stick vertically at arm's length in front of himself or herself. The student then uses his or her thumb to mark off on the stick what appears to be the height of the child standing at the foot of the tall object. Finally, by seeing how many times he or she can measure this distance along what appears to be the height of the tall object, each child will make a careful estimate of the designated objects' height.

Metric units of length, weight, and volume will be introduced. The basic unit of length is the meter, which is about 10% longer than a yard. The meter stick will be compared with a yardstick. One tenth of a meter is known as a decimeter. One tenth of a decimeter is a centimeter. This means that a centimeter is equal to 1/100 of a meter. Centimeters will be compared to inches.

A kilogram weight will be shown. At sea level, a mass of one kilogram has a weight of about 2.2 pounds. One kilogram equals one thousand grams and there are four hundred and fifty-four grams to the pound.

The unit of volume in the metric system is known as the liter. The liter is slightly larger than the U.S. liquid quart. It too may be divided into the deciliter, centiliter, and milliliter, or multiplied into the decaliter, hectoliter, or kiloliter. Each prefix carries a specific meaning as to its value. Students will have the opportunity to measure liquid in liters and its subdivisions.

These new words will be taught in this unit:

acre
bushel
centigram
centiliter
centimeter
decameter
decigram
deciliter
decimeter
dimension
gram
hectometer
kilogram
kilometer
liter
meter
milligram
milliliter
millimeter
peck
perimeter

Follow-up activities for the classroom teacher:

1. Interested students may dig up 1/2 sq. ft. of untrampled soil, four inches deep. Tear apart and count the number of animals. Multiply the number found by two to find out how many are in one square foot. Multiply this by 43,560 to find out how many in an acre. (In an acre of topsoil there may be 50,000 earthworms. These can bring eighteen tons of subsoil to the surface yearly, building a three inch layer to top soil in twenty years).

2. Have the children make tables, charts, or graphs of the data collected in projects such as those described in the preceding activity.

3a. Determine the speed of water flow at a nearby point. This may be calculated by finding the number of seconds a floating object takes to travel 100 ft. This answer times 52.8 will give the time needed to travel one mile.

b. From the result in the preceding step, determine the number of feet the object travels in one second. (If the object travels the 100 feet in 20 seconds, then dividing 100 by 20 gives 5, the number of feet traveled per second).

RESOURCE MATERIALS

Hug, John. *Curriculum Enrichment Outdoors*

Delta Series. *Object Lessons in Science*

Pringle, Lawrence. *Discovering the Outdoors*

Epislon Series. *Object Lessons in Science*

Swan, Malcolm. *Tips and Tricks in Outdoor Education*

Pattison, William. *Going Places Series*

Seymour, Margorie. *Nature Study Facts and Activities Using School and Community*, *Teacher's handbook*

PLOT STUDY--Period of time, 3 sessions, 45 minutes each

CONCEPT: The total environment of an area is affected by air, water, sun, soil, man and animals.

BEHAVIORAL OBJECTIVE: The student will experience, through activities, an understanding of the relationship of living things to their imminent environment.

VOCABULARY: grid sample adaptation variation trace habitat profile environment rare effect introduced popular common comparison estimating

INVESTIGATION: [activities by staff and teacher]

First Session

Divide groups into 3 teams--each with string, cardboard square marked off into 2 inch blocks [2 ft. x 2 ft.], Data sheets [one per child] hand lens--one per child, clip board, ruler, plant press, stakes and hammer. This will be done inside the classroom and the day's activities explained to the children.

Outside each group will redivide into three groups and will set up a plot on the school site. Each staff member will have his three plots in the same general area so that he can help each group. If possible, three different types of areas will be used. The small groups will set up their plots--2 ft. square--this will be a beginning learning experience.

Each group will gather one example of each type of plant growing in their plot and press it in the plant press, as they remove it from the plot they will mark where it was found on the cardboard square. By name if it is known or by a simple picture.

Each member of each small group will have a job in the group.

Second Session

In addition to the other equipment each group will have a trowel, newspaper, glue, thermometer, killing jar, tweezers, and several sheets of Ozalid paper.

The group will carefully dig up all of the plants in the plot, marking them on the plot sheet and then separating them into like piles on the newspaper. Count numbers of each kind and enter on data sheet. Record also any traces of animals and record on the date sheet and put on grid sheet. Record also any traces of animals and record on the date sheet and put on grid sheet. Take temperature at ground level before digging and after the plants are removed. Use the plants pressed to make Ozalid prints for study back in the classroom.

Kill one insect of each type found in the plot and mount, with glue, on each type and put on data sheet.

Third Session

In addition to other materials each group will have a soil testing kit. Dig down six inches and separate the materials found on a newspaper. Put kinds and numbers on data sheet. Test the soil at this level and take the temperature. Record on the data sheet.

Make a soil profile by measuring the width of each soil type, taking some of each soil type and glueing, in layers the right width, on a piece of cardboard. Fill the dirt back into the ground level and remove stakes and string. Back in the classroom compare numbers and types of plant and animals. Discuss what was different and why.

Questions to be answered by the children during the activity [to be used by staff and teacher as guides and help for the students as they work].

1. How many kinds of plants were found here?
2. Do any have seeds? If so, how do you think the seeds traveled?
3. Does all of one type of plant grow in the same spot in the plot?
4. Do any of the same type of plant differ from each other? Which is the most common type of plant in your plot? The rarest?
5. If there are any small trees, check to see where the "mother tree" is located.
6. What animals are found in the plot? Which are using the area as a habitat?
7. How are their bodies adapted for this area? [color, shape of feet, covering.]
8. What might be each animals "job" in this community?
9. What other animals might come to this area for food? Why wouldn't they live in the area?
10. Why is it cooler under ground? What effect would this have on what lives in the area?
11. How many kinds of soil did you find? What makes them different in color? Feel? Smell?
12. What did you find in your plot that can help make soil? What is making soil now?
13. How does your plot differ from the other plots? Why?
14. Which plot has more kinds of plants? Of animals? Why?
15. How has man changed your plot? Is this good or bad for this environment? Pro and con.
16. What do you think would happen if this plot were left alone for a number of years?
17. What man-introduced plants do you think are in your plot? Was this done on purpose or by accident?
18. If the plants were introduced by accident does their presence help or hurt the environment here? [Thistle, dandelion]
19. If any of the soil samples are different in the test what caused the difference? What effect might this have on the plants growing in the plot?
20. What effect will the plants have on the soil?
21. What effect do animals have on the soil?
22. How do the plants in your plot help the animals there?
23. What might happen if we took both the plants and animals away from the soil?
24. What happens when man does this? [as in paving large areas]
25. How can man help restore the balance of nature?

FOLLOW-UP ACTIVITIES FOR THE CLASS [These are suggested activities for the teacher to do outside with the children, some can be used as individual tasks for the students.]

1. Leave the plots alone and check to see what plants are the first to start growing. Try to locate where the seed might have come from.

2. Plant some flowers in the plots and watch how they grow.
3. Check and see what minerals are present. Add needed minerals to one plot and leave the other alone. Plant the same kind of seeds in both and watch each grow. Record the results.
4. Take soil from all of the plots inside in cans and plant the same type of seeds in each can. Shade the sun from one can, give one can less water. Put one can near heat. Record differences in each. Check soil to see how compace it is. Try this test on different parts of the school yard. Take two juice cans and take both top and bottom from them. Put them inside by side in ground that is different [where grass is growing, on bare spot] pour the same amount of water into each and time how long it takes for the water to sink into the ground. Be sure the cans are driven a little into the ground so the water will not seep out. Try this in several places. Notice that the roots help the water soak into the ground and that the bare spots will hold the water. If the cans were not there the water on the bare spots would have run off, without any water going into the ground, therefore, few plants would have a chance to grow.
5. Put some rocks or tiles on the bare plots. Check to see if any animals "move in".
6. Try to make an "earthworm" farm in one plot.
7. Put some plastic bags around plants and tie tightly. Check in the mornings to see what moisture has formed.
8. Make traps to catch insects passing through the plot. Water put in jar lids and sunk into the ground at the ground level will catch crawling insects. A piece of sticky paper hanging above the ground will catch the flying insects.
9. Find areas like the plots studied. Transplant plants from one area to the other. Watch to see how they grow.
10. Suggest that the children find a "plot" that has a different community near their homes and see how it is both different and alike from the school plot.
11. Look for habitats that are alike and different from those found in the plots and see why.
12. Check the school site as a whole to find the most common plant growing there. The rarest one. This can be done by making a circle of a coat hanger. Let the children throw the circle about 20 times around the school site. See which plant most often appears within the circle. Which shows up the least. This is random sampling [akin to TV ratings]. Check this against the results of the plot study. Are they the same or different? Why?

ENRICHMENT ACTIVITIES--Many of these can be used as individual tasks or more study by interested student.

1. Try to identify as many plants and animals as possible from the plots.
2. Use the plants that were pressed to try several kings of prints. Ozalid, spatter, carbon paper, ink, blueprint [directions available from Environmental Education office].
3. Use plants to make rice paper and glue pictures. Pressed flower pictures with clear contact.
4. Find out how some of the plants got their common name. [Dandelion]
5. Research the kinds of grasses growing on the site. See how many types are growing there. Find out why several types might be used instead of just one type.
6. Pretend you are one member of the natural community and write a story explaining what your "job" is in that community.
7. Gather some seeds from different plants that travel by the wind and have a "race" to see which will go the farthest. Wind outside - fan inside.

8. Count the number of seeds on one dandelion to see how many it produces [pick one at a time and stick on sticky tape to hold it].
9. Take a paper bag around the school site and collect all the seeds you can find. Sort them as to types and kinds and make a display with them. Use medicine bottles or clear contact.
10. Find pods and use them for decoration. Teasels, Milkweed and pinecones are some. They should be dried, hung up and sprayed with a clear spray. They can then be painted or sprayed.
11. Use a pinecone to make a bird feeder. Fill the cracks with peanut butter and stick sunflower seeds into the peanut butter. Hang outside on a tree. Refill after the birds have eaten the seeds and peanut butter.
12. Collect seeds to make a picture. Mosaic pictures are very effective. Milkweed down can be used as clouds.

Correlation with other subject areas. [Suggest to subject area teachers.]

SOCIAL STUDIES

1. Relate the week studies to the agriculture and economy of an area. How do they increase the cost of production? What have the Agriculture Departments of state and county done to reduce the waste or loss of food? How are some of the week plants dangerous to livestock [Thistel]? Why do some states check all cars coming into their state?
2. What part do common weeds and grasses on the school site play in conservation?
3. Relate the natural community to the man made one. What basic "jobs" are the same? Why would the man made community have more types of jobs?
4. Study the natural community frome the standpoint of the natural resources. What would be the commercial value of the trees and plants on the school site? Which are most valuable from the aestheic standpoint?
5. Judge the school site as if it were a poineer or Indian homesite. What might the poineers and Indians find on the site that they could use in their living?
    Ink - Pokeberries, elderberries
    Food - Berries, roots, greens
    Tool handles and weapons - Hickory, Ash, Osage Orange
    Seasonings - Sour grass, Hackberries
    Dyes - Dandelion roots, grapes, sumac berries, hickory bark, walnut hulls, osage orange bark, mullein juice
    String or rope - innerbark of basswood and hickory, mullein
    Drinks - sassafras, sumac berries, chickory
    Medicine - May apple, witch apple, sweet flag, boneset, heal all.
    Toothbrush - Dogwood or sassafras twig
6. Do some research to see how many of these things are still being used today. What new resources have supplanted them?

LANGUAGE ARTS

1. Write a story that tells about the kind of community found in the plots. How each member helps the other. Do it as if you were reporting for a newspaper, or writing a short story.

2. Write a "Help Wanted" advertisement for one of the community workers. i.e.
Wanted:

A good plow that can work on year round basis to maintain loose soil. Call BArrow - 57934 [Worm].

Experienced messenger needed to carry valuable load daily, many stops. Call HIve - 57987 [Bees with pollen].

3. Make believe personal interviews of the community workers could be done in the form of TV interviews, group discussion or panels. Children could be asked to take part of a community member and be questioned as to his position and work.

4. Legends and Myths can be written about plants found in the plot. i.e. Why does the dandelion leaf have teeth? Why do some clovers have 4 leaves? One child might pretend to be a story teller and tell the rest or the class might divide into groups and act out the Myth.

5. Write a story involving the adventures of a seed. "Around the School Site in 15 Days or How My Dandelion Parachute Carried Me on A Trip".

6. Let the children make up names for the different plants, using how they look, smell, and feel as a basis for the names.

7. Interested children might write a booklet on "Plants of Our Schoolyard".

8. Letters can be written to government agencies requesting information on dangerous weeds, special types of grasses and other information.

MATH

1. Use the numbers already found in the first surveys to make graphs and work on random sampling and ratios.

2. Use the plants gathered to study the use of sets in nature. Check plants with even numbers of leaves etc. with odd. See which is most common.

3. See how many math shapes can be found in the plants.

4. The plot was marked off in a 2 foot square. Try making a 5-inch square, 3 ft.

5. Make the concept of an acre of land come alive by pacing it off with the children on the school site. Use the children as markers so they can see the acre of land enclosed by the class.

FILMS Available from the Materials Center.

Why Plants Grow Where They Do, SC 25 11 min.

Animal Homes, SC 194 11min.

Ants - Backyard Science, 328 11 min.

Life In A Cubic Foot of Soil, SC 348 11 min.

Living Things Are Everywhere, SC 357 11 min.

A Plant Through the Seasons [Apple Tree] SC 406 14 min.

ENERGY UNIT

Aim: To show students the need to conserve energy, what energy consists of and how it is made.

Objects: To show the student how the increased need for energy has depleted much of the supply. To show the students what energy is, where it comes from, and what it is used for in both the home and community.

Energy, in its simplest terms is what makes things go. It is not only the elements that move things, or supply things, but it also makes things grow. We depend on food, and food is a part of energy. Plants are made so they get their energy from the sun. In fact, the sun provides energy for everything. There is a flow of energy in nature. Plants, animals, and humans will interfere with this flow, catching it, then redirecting it and using it to change or shape the universe in their own ways. Energy, however, is not something apart from material things, but a part of everything. In most energy resources there are six steps involved in its use (as developed by Daniel Luten, Scientific American, September, 1971):

1. Recognizing that a substance is a resource that can be used to do work.
2. Harvesting the resource
3. Transporting it
4. Storing it
5. Putting the resource to work
6. Dealing with by-products

Each of these elements can be explored with activities and discussion. Along with learning these elements, a student should be made aware of where mankind has been, where it is now and where it is going. In this context the story of mankind's continuing effort to reshape the world and the inevitable cost of doing that makes pollution not an unlucky accident, but simply the natural result of the way we use energy. The human animal has been able to change his environment. Some of the questions that now must be answered are: "Has this always been for the better? Can there be too much progress? Can the price be too high? What can EACH one of us do to help?"

In answering these questions, none of which has a "right answer" the students should be able to see the complex questions facing all of us and how energy flows through each of our daily lives. Faced also must be the alternatives to our lifestyle at a time when we all desire ever more energy, rich goods, and services.

What is energy? Energy is the capacity to do work. Just as our bodies must be fed fuel in the form of food which is burned to create energy, so must machines be fed fuel or power in order to perform work. Many people think of electricity as fuel. It is not. Fuel materials such as coal, oil, gas and uranium are converted to electricity in power plants.

Sources of Energy

Fossil Fuels (non-renewable resources)

- Natural gas	This is a relatively clean fuel, but is currently in limited supply.
- Oil	Great supplies are available but pollution occurs from oil spills, refineries, and from the burning oil.
- Coal	Substantial supplies are available, but severe environmental problems attend the mining and burning of coal.

Renewable Resources

- Solar energy	This appears to be a very clean source. Useful applications are now being made on a small scale, but extensive long-term research is needed before it can be used for large scale generation of electric power.
- Geothermal	This is a relatively low-polluting source. Problems involve hydrogen sulfide emissions, saline discharges, possible earthquakes.
- Hydroelectric power	Dams and destruction of scenic amenities pose serious environmental problems.

Nuclear Energy

- Nuclear power	Problems involve thermal pollution, some discharge of radioactivity, the disposal of radioactive wastes, and the remote possibility of major accident at the power plant. Pollution and safety problems also attend uranium mining, nuclear fuel preparation and transport.
- Nuclear breeder reactor	Could stretch our uranium supply but would multiply dangerous plutonium by-products. Still experimental.
- Thermonuclear fusion	Hopefully a source of abundant and relatively pollution-free energy in the future. Probably 40 years from becoming a reality.

Other Developments

- Gasification or liquefaction of coal	Converts coal to a cleaner fuel (gas or liquid) but pollution problems can attend the conversion process as it is now envisioned. Problems of coal mining remain.
- MHD (magneto hydrodynamic power)	A more efficient way of producing electricity from fossil fuels by using ionized gases in the generator.
- Fuel cells	Can convert chemical energy directly into electrical energy. These are now being used experimentally.

Are you aware that:

1. The U. S. with 6% of the world's population uses 35% of the world's energy, and our demand is doubling every 15-20 years. Demand for electricity is doubling every 10 years.

2. The U. S. may run out of low and moderate cost natural gas, oil, and uranium in less than 30 years.

3. All forms of energy will cost more in the future because of scarcities, and because in the past environmental and social costs were largely ignored.

We must see an immediate need for a nationwide effort to conserve energy. This effort should involve industry, government and the individual. Citizen participation is essential. It is a position that by lessening our demands for energy we will help achieve the following goals:

- Stretch our dwindling supply of fuels.

- Buy valuable time to research and develop cleaner and safer sources of energy in the future.

- Lessen adverse environmental impacts which result from the production, distribution and use of current forms of energy.

We should all begin to evaluate our essential energy needs now and to cut use accordingly.

I. Recognizing an energy resource: All things contain energy, that is, all things have the potential to accomplish some form of work, to cause motion (sometimes experienced as heat or light). When we figure out a means of tapping the energy in a thing we call the thing an energy resource or a fuel. Many energy resources lay unknown and many may still be undiscovered. Oil for many thousands of years was just a black fluid until someone figured out how to burn it. Today there are many varieties of fuel resources used in our culture - coal, oil, uranium, natural gas, wind, sunlight, electricity, water, steam, food, wood, and garbage.

Activities

1. Discussion - How many different types of fuel are used in our community? Divide the class into committees. Have each committee explore and present a program of one form of energy used in the community. Have each committee prepare a section of an exhibit on energy - what it looks like, where it comes from, how it is measured, and what is its cost.

2. Invite speakers from companies that supply each type of energy to the community. Be prepared to ask such questions as, "Why is this form of energy the best? What are its limitations? Where does this energy come from locally? What are its drawbacks? What are its potentials for pollution? What are its by-products and side effects? What is its cost? How does its cost here in this community differ from other communities?"

3. Students could prepare reports or a play about the "discovery" of a fuel. Discuss the difference in the use of fuel from the pioneers and Indians until today.

4. Using a check sheet, have each student list the types of energy used in their homes. They should also check with their parents to see approximately how much is used per month and the cost. They should also ask their parents why that certain fuel is used?

5. Take a walk around the school. Locate the source of energy for the school. Question the custodian as to the amount used per month, where the energy is coming from, and what his job is in relationship to the energy.

6. Survey the room and the school building. See what items used in the construction of the building and the contents needed energy to be made. Discuss alternative materials and the pro and con on each.

7. Put groups of students on each corner of the school yard. Have them list all the forms of energy they see in use (including animals, etc.) and trace the source of the energy.

8. Have the students play "the Energy Game"

Everything needs help to live. This means that things depend on each other. You depend on many things to live. Can you think of some things that you depend on?

Do you need food to live? What do you depend on for food? You can depend on someone to buy the food. You can depend on a grocery store to sell the food. What you depend on to be the food? Food gives you energy.

Plants and animals need energy to be strong or even just to grow. Animals get most of their energy through food. Food for animals could be other animals or plants.

Plants are different than animals. Most plants cannot eat animals or other plants. They are made so that they can get energy from the Sun.

When we eat, we get energy that is really from the Sun. The Sun supplies the energy for everything.

Here is a game that your troop can plan and see how important the Sun is:

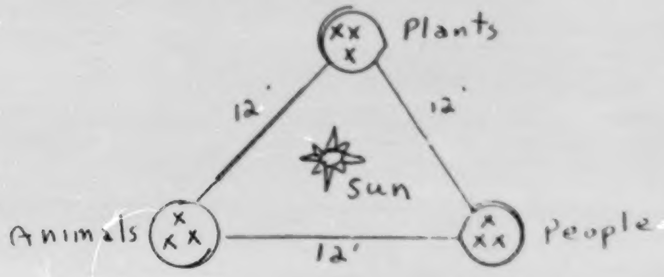
To play the game the troop needs:

ONE BIG BALL (like a beach ball or basketball) and THREE PIECES OF STRING OR YARN that are 20 feet long.

Choose someone to be the Sun.
Choose three people to be plants.
Choose three other people to be animals.
Choose three more people to be people.

Form the string into a ◯

Put them twelve feet apart like this:



The "Sun" stands in the center.
The "Plants" and "Animals" and "People" sit in their circles.

The "Sun" throws the ball to the "Plants".
If a "Plant" catches the ball she may stand up and throw it to the "Animals".

The "Animal" who catches the ball may stand up and toss it to the "People".

The "People" who catch the ball may then stand up and throw it back to the "Sun."

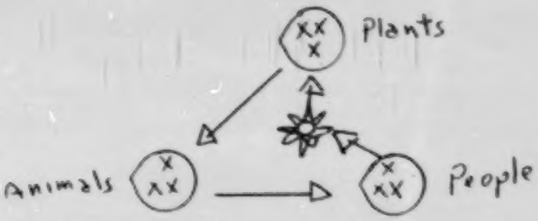
Rules

1. Each "Living Thing" must catch the ball once before she can stand up. Then she can keep standing.

2. If a player steps outside the string-circle, a new player may take her place.

3. Each "Living Thing" must catch the ball once in four rounds, or she must leave the circle, and another player takes her place.

Try the game with 5 plants, 5 animals and 5 people.



II. Harvesting the Resource

In using the word "Harvest" you are explaining that the most ancient form of fuel gathering was the gathering of food. Each form of life must have some way to gain energy, if not for themselves, for the more sophisticated uses as demanded by man. Harvesting raises many interesting questions, but probably the most important is, "Who owns the harvest? Should one group of people or nations be penalized because it was an accident that vital sources of energy were determined by a man-made boundary? (i.e., the Arab oil) If an energy source is found on the moon, to whom should it belong? To the country who made the discovery or should the source be used for all? Who owns the moon? Who owns the water? Is it all right for a nation or state to harness water power if this interferes with the flow of water into a neighboring state or country? A good example of this is the international fight over fishing rights.

Activities

1. Have a United Nations type debate over the use of the ocean. If food from the ocean is ever harvested who will own it? Find stories about the Great Britain-Iceland dispute over fishing rights.

2. Have a committee investigate mining rights. Who owns what in this country? in other countries? If materials such as oil, coal, etc., extend into someone else's property, it is legal for someone to tap into the supply?

3. Invite professional miners, farmers, geologists, to speak to the students about their work.

4. Visit a nearby "harvest" place - dam, mine, thermal transfer plant, forest (where firewood is still cut). Point out that 100 years ago wood was the major fuel in America.

5. Make a model of a wind mill or water mill. If there is a stream on the school yard, put the model to work.

6. Keep a wind chart for a week. Figure out how much fuel might be "harvested" from the wind.

7. Keep a sun chart. See how much energy might be made if solar energy were used.

III. Transporting the Resource

Transporting energy is also an energy user. There are many problems concerned with trying to get fuel from one place to another. This is one of the links between the energy crisis and the environmental crisis. Oil spills, the Alaskan pipeline, gas leaks, and other problems must be considered in studying this phase.

Activities

1. Using knowledge gained in other activities about the sources of fuel in the school, committees can study the means by which fuels are delivered to the home and school. What are the routes that are used to bring in electricity, gas, oil, and coal? Who is responsible for seeing that these fuels arrive on time? What happens when these ways to transport the fuel fail? Ice storms, broken pipes, strike of drivers, and other happenings can be discussed.

2. There has been a great deal of discussion about environmental impact. Discuss with the class what it means and what damage can be done if an oil leak occurs in (a) the ocean, (b) on land. What can be done to prevent such accidents?

3. Ask a service station operator how much gas he stores in his underground tank. Try to figure out the number of cars that could be served (average 15 miles per gallon - gas tank holds 20 gallons) from the tank.

4. Map the fuel delivery channels on a map of the neighborhood. If possible, get a map of the oil or gas lines from the gas company. Try to get a representative take the class on a walking tour above the gas line.

IV. Storing Energy Sources

Each type of fuel poses problems for its storage. Some types of storage require special containers. Some are dangerous to handle. Many require large containers that must be placed away from homes and businesses.

Activities

1. Visit as many actual sites for storage as possible. The school itself, gas stations, supermarkets, gas or oil storage tanks. Before the trip, have students prepare questions about the cost and dangers of different types of storage.

2. Have the students compare procedures for storing food fuels (freezing, refrigerating, canning, drying, etc.) with those for storing gasoline or atomic fuels.

3. Divide the group into committees to study the problems involved when storing fuels aboard moving machines (cars, airplanes, rocketships, trains, human beings). Discuss the dangers (relate to recent accidents with people putting gas in trunks of cars).

V. Putting the Resource to Work

In order to put an energy resource to work the resource must undergo a process called conversion. Most forms of conversion are highly technical, the basic idea is simple. Most conversions involve (1) an input - the energy resource to be converted, (2) a conversion device, (3) the output - the work which results, and (4) by-products. Many times an energy resource undergoes processing before it is converted for our use. Wood must be refined into charcoal and oil into gasoline. This is a major U.S. industry. Much is done in the food-fuel area to change one type of food into another. Each of these changes also takes energy and many energy conservation people attack the convenience food industries for this reason.

There might be some confusion about what exactly is a conversion device. Some people would call a car a conversion machine. (input, gas - output, transportation) It is best to keep the concept as simple as possible. The human body is a type of conversion machine. Green plants convert solar fuels to cells. What humans did was to harness animal machines to replace the human machine to do work. The step from there was to machines that did the work. A point to remember is that often different energy conversion devices do the same work.

Activities

1. With the students list some common conversions and figure out the inputs and outputs (light bulb - input,electricity - output, light by-products, heat).

2. Have the students hand crank ice cream or shake cream into butter. This shows that processing food can also take energy.

3. Using pictures or charts, list changes in "machines" from around 1870 until now. Such items might be: ice for refrigeration, oil lamps, beating a rug, hand saws, hand tools of all types, straight razor, drying hair on bobby pins, water pump, hand washing and wringing, chopping wood for fire, cutting grass with sickle.

4. Have the students make a list of the "labor-saving" machines in their homes. Which five machines would you be willing to do without? Which is the most important one to you? to your Mother? to your Father? If you had to give it up how would your life be changed?

5. If several types of energy conversion devices can do the same job, why invent a new device? (i.e., if the sun can dry clothes, why have a dryer?) Have the students make a list of the conversion devices they use in a day and compare them with older devices. Then have them try to explain the benefits of the modern devices. (faster, making more free time, better job, life easier by saving labor, etc.) Have the students study ads. See what claims are made to show the public why they should buy a certain "useful" product. Take these supposed benefits and analyze them. How do people use the free time given them? If physical labor is to be saved, why do some people climb mountains, hike, engage in sports, and do other physical things? If machine items are better, why do people value hand-made crafts? Why do people learn these skills?

6. Have the students list different types of fuel and discuss why one might be better than another (e.g., gas vs. electricy, wood vs. coal, oil (for light) vs. electricity).

7. Examine other countries. What types of fuel resources are used that are different from those used in the U. S? Are they having the same problems as we are? Are they getting the work done with what they have? How is the life style affected?

8. What are some alternatives to the energy sources we are now using? What are the advantages and disadvantages of each? Solar - What is done when there is no sun? Water - other than through generators (the hydraulic ram), wind - windmills, methane - an ignitable gas made from organic wastes and water.

VI. Dealing with By-Products

While we usually think of conversion devices as producing a single product (lightbulb - light) the reality of conversion is much more complex. There can be many secondary effects - noise, smell, smoke, heat. Usually the terms waste and pollution objectivity describe bad effects of the converstion process. These terms, however, are in reality value-laden terms that merely represent our way of looking at things. City people consider animal excrement "waste" but it is very useful to the farmer. It is best then to use the words by-product or side effect in discussing the non-primary outputs of conversion devices. There are four basic questions to be asked about these by-products: (1) do they have any value, if so how can it be obtainea? (2) what becomes of these by-products? (3) what is the cost of getting rid of them? (4) who pays?

Activities

1. List conversion devices that are used in home, school, and industry. What are the by-products of each? What happens to each by-product?

2. Try to "Brain storm" uses of by-products. What would be called "Pollution?" Read about such areas as Copper Hill - how the fumes destroyed the area and then were found to be useful. The "hot water" uses of Atomic piles (catfish farms). The thermal transfer plan and its uses.

3. Check out local recycling projects. See what could be done at the school. What could be done with all of the waste there? Where does it usually go?

4. Check out what effect trying to stop pollution has on the product itself (i.e., emission controls on cars cut down on gas mileage).
   Debate - more energy needed vs. letting up on controls for pollution
   Debate - the Alaskan pipeline, need for oil vs. ecology
   Debate - need for power vs. recreational uses of the Little Tennessee River.

5. Outside - check to see how nature uses by-products of its energy. Dead leaves turning to soil, mold, etc.

VII. Where Do We Go From Here?

Perhaps the most shocking fact of the energy crisis is that we don't have many options - only two paths are open to us.

Status Quo - To continue doubling (U.S.) our energy consumption every ten years and run the risk of using up the available energy resources we now depend on before the year 2000. In this way lies higher energy bills, increased pollution of air, water and land, competition and conflict with other nations for energy resources found elsewhere. The hope is for a new source of energy.

Energy Conservation - It encompasses three basic strategies, each of which aims at having us use less energy or at least slow down on what we now use. Improved efficiency - this means getting more work from the same energy - more miles per gallon. This is largely a matter for engineers, but all can help by driving better and car-pooling. Switching conversion devices - different devices can often do the same job. Flourescent lights use less energy than the bulb. The human body is a wonderful conversion machine. It can save energy by doing things machines now do. Limiting Uses - perhaps the most extreme. Cut down on energy by limiting the use of TV, cutting down on power and heat, cutting off light when not in use. Below are some ideas for limiting use. Try some and check on how well it was done.

Power (gas and electric)

Save power, save resources. Decrease the energy you consume every day and you will save money, too! Energy that we all use in our homes and cars is made from fossil fuels like coal and natural gas. There is only so much of this kind of fuel. Someday it will be gone. We are, in this country, doubling our use of electricity every ten years. Part of this demand comes from increasing numbers of people, but some is from all the "power" tools and appliances, from radios to toothbrushes, that are increasing in use. Power production is also a major factor in air pollution. Watch an electricity generating plant in the Nashville area for a day or a week! Improvements have been made but much more must be done. You can become informed and encourage this improvement by industry and you can help by reducing your own use of power. Here are some money and power saving do's and don'ts:

General Household:

Heating. Keep heaters free from obstructions. If you cover a radiator or block off a heat duct, the heat from that source is cut off and the room temperature will drop.

If the garage and attic aren't heated, keep the doors closed which connect with the rest of the house.

Change or clean furnace filter several times during the winter. A furnace with a dirty or clogged filter cannot operate at maximum efficiency.

Set the thermostat at the temperature desired and leave it alone. Don't waste money by playing with the thermostat. Turning up the thermostat does not make the furnace produce more heat. It only keeps the furnace operating.

Keep the opening and closing of doors to the outside to a minimum so that heat does not escape from the house.

If you have a fireplace, keep the damper closed when it is not in use, or block the opening with a movable cover such as plywood or insulating board.

If you are planning a winter vacation, why not give your fuel bills a vacation, too? Before you leave, turn the thermostat down to the lowest setting.

Check the insulation in your home. Seal all cracks and crevices especially those found under the roof. If cold drafts are entering through corners, windows, doors and other areas, seal the area tightly.

If you have air conditioning, be sure it is in good working order before warm weather starts. Improperly working air conditioning costs more in fuel and money to operate.

Turn off all lights in unused areas.

Check for leaky faucets around the house. They could be draining away hot water.

Try to use your appliances to full capacity. Save time and money by putting reasonably full loads (but not overloads) in your appliances.

Never use a range or oven to heat a kitchen -- it was not designed for this use.

Cooking

Utensils - pans should have tight-fitting lids to save steam and pans should fit the unit of stove.

To cook vegetables - season with butter and add just enough water to the pan to keep them from burning. Steam vegetables, do not boil them. Cover pan tightly - except when cooking spinach. Water is the most expensive thing to heat on any fuel. Vegetables retain more food value if steamed rather than boiled. Bring things to a boil, then turn down temperature as far as you can to maintain boil. Never overcook food -- get it done when you need it. 3-10 minutes of heat is left in electric burners after turning it off.

Frying - Make sure frying pans fit unit. Put small things in small pans. Heat quickly, then turn down to maintain cooking heat. For soft eggs - remove bacon, add eggs and an eggshell of water, cover.

Oven cooking - never use oven for one thing. Cost of heating up oven is the most expensive - maintaining heat costs much less. Do complete oven meals to save. Keep door of oven shut -- no peeking. Cold air will cause cakes to fall. If unsure of oven, have it checked to save money. During the last 10 minutes of cooking in the oven, it can be turned off (as long as you don't peek) as it retains heat well. Never use oven to toast bread.

Ironing

Heat iron once for whole laundry. Don't iron one item a day. Maintain heat; do not reheat.

Refrigerators

Take out all you need in one trip. It is very costly to open refrigerator for one item, especially in hot weather.

Keep seals washed and dryed so they don't leak cold air.

Use room temperature to cool foods, not refrigerator, except for meats which should be refrigerated immediately (especially poultry and pork).

Use cool water in ice cube trays.

Keeping refrigerator defrosted will keep refrigerator colder with less power.

Sleeping

Heating pads should not be left on all night.

Use flannel sheet blankets instead of sheets in winter for extra warmth.

If you use electric blankets, turn on to warm bed, then turn them off.

Use electric portable space heaters very sparingly. Heating up unit is very expensive; once heated up, less expensive to maintain heat.

Small night lights are preferred to large bulbs.

Ways to Conserve Energy

Transportation

Moving people and freight accounts for about 25% of the energy consumed in the United States. Half of this amount is used by automobiles.

Larger cars with more powerful engines consume more fuel than small ones. For example, a car weighing 5,000 lbs. uses over twice as much fuel as one weighing 2,000 lbs. Other features such as air conditioning and automatic transmission contribute to fuel consumption.

- Buy a car no larger or more powerful than you need, without unnecessary features.
- Walk and ride bikes. Half of all automobile trips now cover less than 5 miles.
- Ride public transportation where available.
- Organize car pools.
- Encourage the building of better public transportation systems in your community.
- Have your car periodically maintained and keep it tuned up.

Good driving habits can cut your fuel consumption in half.

- Speeding is a costly consumer of fuel. The average car driven between 75 and 80 miles per hour will consume almost twice as much fuel per mile as the same car driven at 50 miles per hour.
- On the road, accelerate smoothly and ease into stops.
- Do not race the engine.
- Instead of idling the engine to warm it up in winter, drive slowly for the first quarter mile.
- Do not leave your engine running longer than 3 minutes while waiting.

Heating and Cooling

The heating and cooling of our homes, buildings and factories consumes approximately 20% of the total energy used in the U. S. To conserve energy in heating consider making changes and improvements in your own home. If you follow these recommendations you can save 50% on your fuel bill.

- Install or increase insulation.

  1. Where winters are moderate use:
     3 1/2" ceiling and wall insulation for gas heat. 6" ceiling and 3 1/2" wall insulation for electric heat.

  2. Where winters are severe use:
     6" ceiling and 3 1/2" wall insulation for gas heat.
     9" ceiling and 3 1/2" wall insulation for electric heat.

  3. Check attic floor insulation. 6" is adequate.

- Weather strip and caulk windows and doors.

- Install storm windows and doors. Check for other air leakage, particularly in the attic.

- Where glass area is large, install double pane or insulating glass.

- Have furnace checked once a year and change filters frequently.

To cut use of energy in heating:

- Close damper in fireplace when not in use.

- Lower thermostat for sleeping. We suggest 60°.

- By lowering the daytime setting of your thermostat by 1° you use 3% to 4% less fuel. By lowering it 5° you use 15% to 20% less fuel.

- Insulate your body - wear a sweater.

- Discourage over-heating of public buildings, particularly schools and libraries. Pressure managers of public buildings to conserve energy.

To conserve energy in cooling:

Insistence on good architectural design in your own community can substantially reduce energy needs for cooling.

- All buildings should have windows that open.

- Encourage the design of buildings with less glass.

- Shade windows from direct sunlight. Preferably shade them from the outside with trees, window vines, shutters that close, awnings or roof overhangs.

- Close light-colored draperies to the sunlight. This can reduce heat gain by 50%.

- Follow tips in Heating Sections on insulation and air leakage.

To cut use of energy in cooling:

- Illuminate less.

    1. Light fixtures give off most of their consumed energy in heat. Thispushes the need for air conditioning sales. The main function of office air conditioning is to remove heat from excessive interior lighting.

    2. Cut out all non-essential night lighting at home and encourage less nighttime illumination of public buildings.

    3. Large areas should be served by more than one switch.

- Discourage open refrigerator units in supermarkets to display frozen vegetables and dairy products.

- Complain about over-cooling in public places; particulary theatres, restaurants and supermarkets.

- Avoid using air conditioner unless weather is intolerable.

Household Appliances

Currently 20% of our total energy and 30% of our electric energy output is consumed in the home. EFFICIENCY OF OUR APPLIANCES IS THE KEY TO SAVING IN THIS AREA.

The process used to generate electricity is very inefficient now. For every three units of energy produced two are discharged into the atmosphere as waste heat and one is changed into electricity. Up to 10% of the electricity generated at the plant may be lost during its transmission to your home. Gas appliances are 2 to 3 1/2 times more efficient than electric ones in their overall energy use.

Water Heating - Heating water for your home can, literally, get you into hot water - financially! Your water heater, be it electric, gas or oil fed, is the most expensive appliance to operate after the furnace and the air-conditioning unit. It accounts for about 15% of your utility bill. It feeds the ever-active washing machine and diswasher. Therefore.....

- Whenever possible run washing machine on cold water.

- Do not wash dishes under hot running water.

Air Conditioner Units - Installing the correct size and most efficiently designed unit can cut your power consumption for this appliance in half.

To determine the efficiency, check the numbers on the back of the machine. Divide the BTU per hour rating by the number of watts input. You will get a number ranging from 4.7 to 12.2. The higher the number the more efficient the machine. This efficiency check can also be made for clothes dryers.

The most efficient unit of the correct size will guarantee the lowest cost and least pollution.

Refrigeration - The frost-free refrigerator requires 50% more energy to operate than a standard model. The standard model costs between $2 and $4 per month to operate, the frost-free model costs $3 to $6.

The side-by-side refrigerator freezer uses up to 45% more energy than the conventional model.

The average size food freezer costs approximately $4 per month for energy.

If you really need one (most families do not), be aware that a well-stocked freezer requires less energy to operate than a partially full one.

Cooking - The stove accounts for 5% to 7% of your utility bill. Self-cleaning ovens are large consumers of energy.

- Use self-cleaning feature sparingly.

- Use proper size pans for burners to avoid waste heat.

Lighting - Flourescent lights are about 4 times as efficient as incandescent lights, and last 7 to 10 times as long. Twenty percent of the electricity received by a flourescent tube is converted to light, whereas 5% is converted to light when the incandescent bulb is used.

- Use lights in specific work areas, instead of lighting the entire room.

- Turn off lights when room is not in use.

Television - Color television sets consume more energy than the same type black and white model. Solid state sets (both color and black and white) consume less energy than filament (tube) sets. Larger screens consume more energy than smaller screens.

Sets that have the instant turn-on feature are consuming electricity 24 hours a day. This feature costs more for the initial purchase and more to operate and maintain.

- If you have a television set with the instant turn-on feature, unplug set when not in use.

Small Appliances - Electric energy consumed by small appliances constitutes nearly 10% of all residential demand which is more than 3% of our total electric energy demand. This 3% becomes significant when compared to the AEC's use of 5%, the aluminum industry's use of 7% and the steel industry's use of 5% of our electric output.

- Eliminate use of unnecessary appliances.

General Tips for Household Appliances -

- For all gas appliances a switch-operated electric starter can be substituted for continuous burning pilot lights. (At least 10% of the natural gas consumed goes to keep pilot lights burning.)

- Optional extras on all appliances use extra energy. Remember that you have the option not to buy them.

- Demand improved appliance design. Increased insulation would lower energy requirements.

- Try to avoid using your appliances during peak periods of energy use.

Industry and Recycling

Industry accounts for more than 40% of our total energy use. Significant conservation can be made in the area of recycling. High energy-intensive materials should not be used for throwaway items.

Less energy is required to recycle aluminum, paper and many other materials than is required to make the products from virgin materials. Recycled materials should cost less at the market place when the recycling business expands.

- Demand and buy goods made of recycled materials.

Aluminum - Vast amounts of energy are needed to produce aluminum. It is estimated that the aluminum industry accounts for 7% of all electrical energy consumption and 4% of all industrial energy consumption. Products such as aluminum cans, foil, and food containers should not be used as throwaway items.

- Use aluminum sparingly, save and reuse.

It requires only 5% as much energy to recycle aluminum as it requires to produce it from bauxite.

- To assist in the recycling of aluminum, take all aluminum waste to your recycling center.

Beverage Containers - The converstion from returnable glass bottles to non-returnable containers for soft drinks, beer and milk has had a detrimental effect on the environment, as solid waste accumulates and energy is squandered. A University of Illinois study indicates that the returnable bottle system uses approximately 28% of the energy of the throwaway bottle system or the bi-metal can system.

In addition, a beverage in a returnable bottle is less expensive than one in a throwaway container.

- Urge your stores to stock returnable bottles. Buy them and return them.

- Consider a system of mandatory deposits for all beverage containers.

Paper - Pulp made from recycled waste paper uses only about 30-40% of the energy needed to make pulp from wood. Recycled paper products such as towels, napkins, tissues and writing paper are on the market.

- Urge your stores to stock recycled paper products and buy them.

Newsprint - Pulp prepared from the recycling of old newsprint uses 60% less energy than pulp prepared from virgin materials. Recycled newsprint is equal in quality to virgin newsprint.

- Take newspapers to your recycling center.

- Encourage your local government to establish a separate collection of newspapers for recycling.

General Tips - Artificial materials generally take more of our non-renewable energy resources to manufacture than do natural ones.

- Be natural and save energy.

Many items in our society are purposely designed to wear out prematurely. Re-manufacturing these items uses up energy. Having to junk them adds to our solid waste problem.

- Demand that products be made to last.

Further Actions to Encourage - Learn about technologies now becoming available for the recycling of waste products to produce energy. See if these can be adapted to your community.

1. Pyrolysis involves incineration in the absence of oxygen and can convert organic wastes to gas and oil.

2. Plants to generate heat and electricity from the burning of municipal trash are in wide use in Europe. The Union Electric Company is experimenting with this process in St. Louis.

3. Any large complex (hospital, shopping center) that can generate its own electricity can also capture waste heat from the generating process and can heat its own buildings. This is called the Total Energy Concept.

Study and Consider These Proposals

1. A truth-in-energy law, requiring manufacturers to post the annual power requirements and operating costs of appliances. These should be stated on the name plate, price tag, and on every advertisement in which the selling price is mentioned.

2. The establishment of efficiency standards for energy-intensive products such as large appliances, automobile engines and electric motors.

3. A National Energy Policy that will establish a broader base for research on more environmentally sound and efficient means for producing and using energy.

4. Possible limitations on advertising and other promotional practices (including pricing) which serve to encourage increased use of energy.

Activities

1. Discussion - Brainstorm ideas for other types of power. Is there any job that can't be done by machine (power zippers, anyone)? Would limitless power improve the lot of humanity? Are there any problems it could cause?

2. In committees have the students figure out ways to increase the efficiency of devices both at home and school. Try some and check the use of energy over a week or months time. Check the gas and electric meters in the school and have the students keep a chart at home. Check not only power saved, but also money saved.

3. Have students make up a questionnaire and explore the teachers and neighbors about their reaction to cutting down on energy. Would they voluntarily reduce their use of energy? If so, how? If not, why not?

4. Check lighted signs near the schools and homes. Which could be turned off and still not hurt the business? Make up posters asking people to cut down.

Environmental health is a factor that can easily be tied in with energy use. Most of us live in over-heated homes and schools. This can affect our health and ability to learn. Here are some activities to help students understand heating, insulation, and air movement. These acting together can not only create a comfortable or uncomfortable situation, but they can lose or conserve existing energy.

Students may check the variations in temperatures and air movement throughout a dwelling. They will record their findings on a house plan that shows the location of heat sources, air vents, furniture and the location of the temperature reading in relation to these objects. The object of recording this data is to identify relationships that cause differences in comfort. From this information students will draw conclusions about arranging furniture or modifying human behavior to achieve the greatest comfort. These investigations will be most successful in the coldest weather. Individual students and teachers should attempt to design other activities.

The information gathered for this unit will also relate to investigations of air currents and insulation. Can the students who mapped air currents with milkweed comae find any correlation between their temperature maps and their air current maps?

Insulation, of course, affects the wall and window temperatures. Students can discover if their houses are insulated simply by asking their parents or by checking the attic (if unfinished), the crawl space, or the ceiling in the basement near the walls. The insulation will be stuffed between the outer and inner wall of the house.

They may test how well their houses are insulated by following the simple activity about heat loss. This activity should be done when the weather is cold and the furnace is running. Again, the area of the window and how well the windows insulate will be the critical factors.

SOLAR HEAT:

Solar heat is a factor the students may not have considered. If you have a room in the building with large windows facing south, they will make good subjects for comparison. The students should make temperature reading in this room and map the readings similar to the way they mapped temperatures in their homes. This should be done once about noon on a sunny day and once about noon on a cloudy day. How do the maps compare? Does solar heat effect the temperature of the room?

Encourage the students to discuss and support their conclusions. This discussion should provide the teacher an opportunity to evaluate the students' insight into the environmental factors under investigation and whether they think control of these factors is possible.

It is suggested the teacher keep this background information in mind when generating discussion of the student activities in this unit. The activities provided here are designed to allow students and teachers to work cooperatively through the four steps of solving simple problems:

1. Stating an interesting problem or question.
2. Collecting information or data relevant to the question or problem.
3. Analyzing the data or information.
4. Drawing conclusions.

LEARNING ACTIVITY DESCRIPTION

Materials: thermometers (Centigrade or Fahrenheit) and work sheets

The teacher can best help the students by explaining what is expected of them and how they are to proceed. All of the student investigations should be conducted in their homes. Trial runs should be conducted in the school building before the students make investigations on their own. Instructions and data sheets are included for each investigation. Discuss each investigation thoroughly before sending the materials home with the students. Use Centigrade thermometers if possible. Converstion tables are provided. It is suggested that discussions take place after each investigation so students can share data and compare their findings and conclusions. The questions provided with each investigation may serve as a starting place for discussion.

EVALUATION

Investigation #4 is actually an evaluation exercise. You may use it to determine how well the students learned the lessons of the first three investigations.

If discussions were conducted after each of the first three investigations, you may wish to design evaluation activities which would require students to do some of the following:

1. List three factors that affect their comfort in a room.
2. Describe the effects of solar heat on the inside temperature of their home.
3. List reasons for temperature variations within a room.

Always keep in mind that your evaluation techniques or instruments should be designed to draw from activities or discussion in which your students participated.

Parts of this unit were taken from the following resources:

Concern, Incorporated, "Eco-Tips #5", 2233 Wisconsin Avenue, Washington, D. C.

"Spaceship Earth," Girl Scouts of Metropolitan Detroit, 153 E. Elizabeth, Detroit, Michigan

Environmental Education Division, State Department of Education, St. Paul, Minn.

"Starting Points - Energy", Learning Magazine, December, 1973

INVESTIGATION #1

HEAT LOSS

PART 1

A. Select a room on an outside wall to test for heat loss.

B. Draw a map locating doors, windows and heating devices that are located on each wall. (Master 5)

C. Make temperature readings midway on each wall at the following locations:
1. near the floor.
2. at shoulder height.
3. near the ceiling (stand on a chair).

Record your readings on the temperature map.

D. Determine where further readings should be taken. Record all readings. Select areas you feel would indicate temperature variations.

PART 2

A. Close all of the heat registers in the room to be tested. Cover all openings to other rooms with blankets or towels. Close all doors to the room.

B. It is best to investigate the room temperature during the time of day that the room is not used very much. Ask your family to not use the room for two hours.

C. After two hours, go into the room. Leave all doors, registers, and openings closed or covered. Make a temperature map similar to that in part 1.

D. Questions:
1. How do the two maps compare?
2. Was any heat lost?
3. If there was heat loss, what might account for this?

TEMPERATURE MAP DATA SHEET

WALL #1

WALL #2

WALL #3

WALL #4

Circle one: Part I Part II temperatures at the center of the room:

ceiling ____________________

shoulder height ____________

floor ______________________

Location and temperature of other readings:

____________ ____________

____________ ____________

____________ ____________

ANSWERS TO QUESTIONS

INVESTIGATION #2

COLD AIR AND DOORS

A. Use the milkweed comae provided by your teacher to see if air currents are entering around the doors of a room. Record your findings on the data sheet. (Master #3)

B. Take temperature readings:

1. next to the door,
2. two feet from the door,
3. four feet from the door,
4. in the middle of the room.

C. Questions:

1. Is cold air coming in the door or is warm air going out the door?
2. How many doors do you think the ideal home should have?
3. Was loss of heat the only factor you considered in answering question number two?

DATA SHEET

A. Draw a picture of the door you studied and any air currents you discovered. (Draw map on back of this sheet).

B. Temperature Readings:

1. next to the door ____________________
2. two feet from the door ____________________
3. four feet from the door ____________________
4. in the middle of the room ____________________

C. Answer to questions:

INVESTIGATION #3 – WINDOWS AND HEAT LOSS

A. Read and record the temperature at several windows in your house. (See Illus. Below) Place the thermometer bulb as close to the window as possible. Allow time for it to adjust.

B. Read and record the temperature one foot away from the glass.

C. Read and record the temperature at the center of the room.

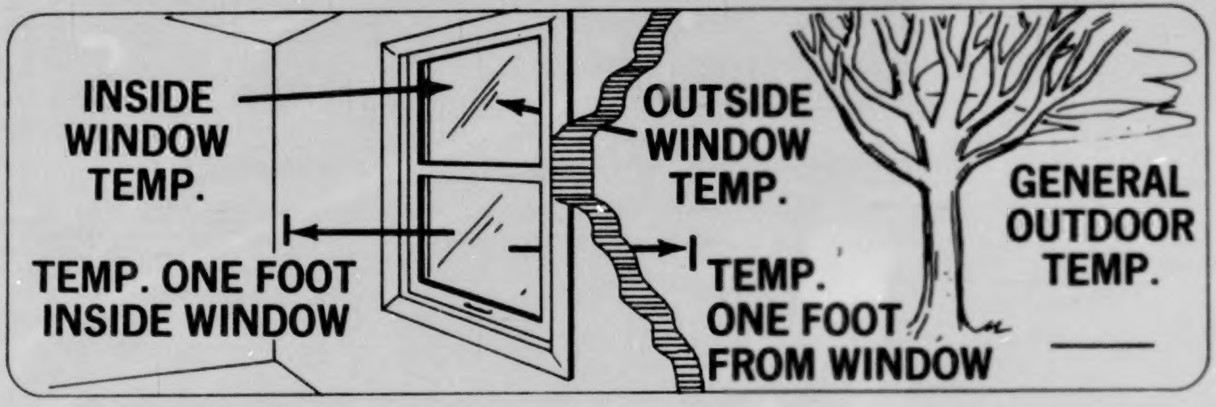
D. Go outside and take readings:

1. on the window
2. one foot outside the window
3. ten feet from the window

E. Questions:

1. Are your windows responsible for some heat loss?
2. Does the size or shape of a window make any difference?

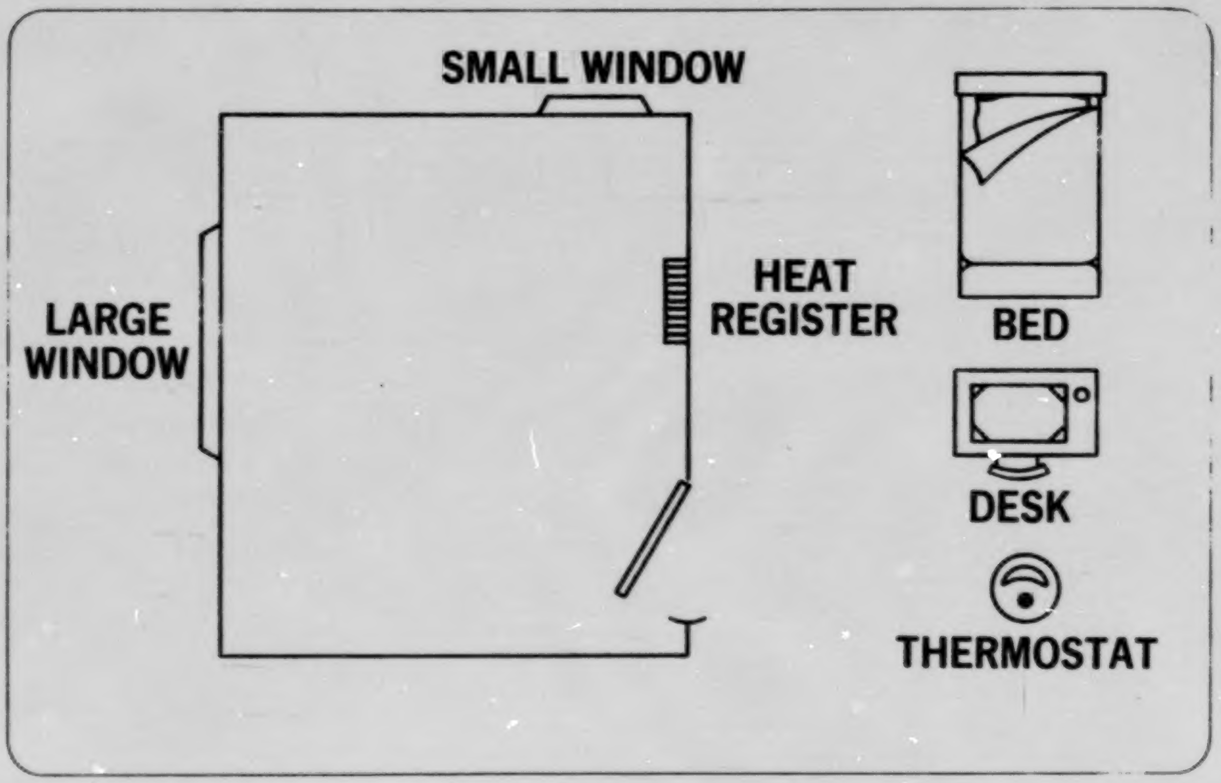
A. Record your data.


INSIDE WINDOW TEMP.
TEMP. ONE FOOT INSIDE WINDOW
OUTSIDE WINDOW TEMP.
TEMP. ONE FOOT FROM WINDOW
GENERAL OUTDOOR TEMP.

B. Answer the questions.

INVESTIGATION #4 – PLACING OBJECTS IN A ROOM

Using what you have learned from investigations 1-3, place these objects in the room to provide the most comfort.


SMALL WINDOW
LARGE WINDOW
HEAT REGISTER
BED
DESK
THERMOSTAT

Explain why you arranged the objects the way you did.

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USING ELECTRICITY

STUDENT DATA SHEET #1

Go through every room in your home and record the items which use electricity and place them under the function they perform:

	LIGHT	HEAT	WORK	COMMUNICATION	MISCELLANEOUS
	Lamp	Hair dryer	Drill	Radio	
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					
11.					
12.					
13.					
14.					
15.					
16.					
17.					
18.					
19.					
20.					

USING ELECTRICITY

STUDENT WORKSHEET #1

Divide the items from your data sheet #1 into three groups — items that are necessary, items that are luxuries, and debatable items.

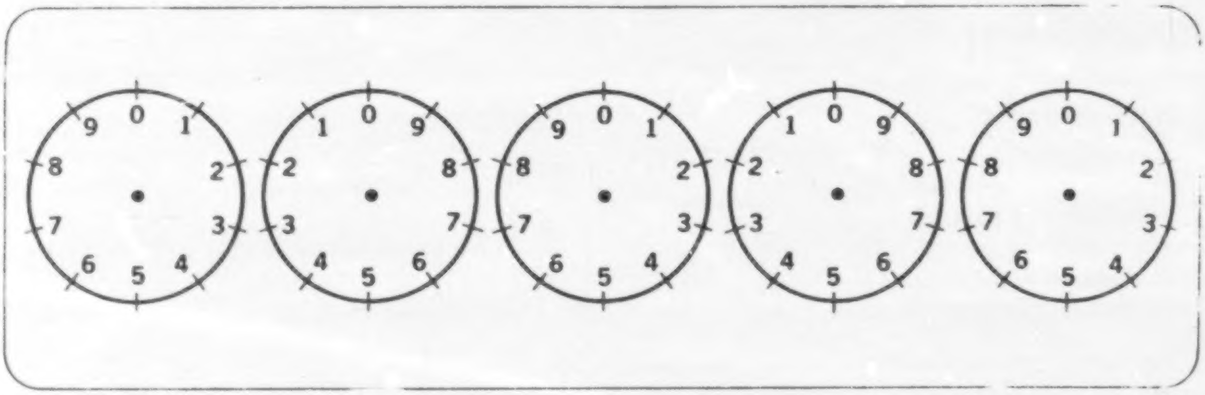
NECESSITY	LUXURY	DEBATABLE
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		
17.		
18.		
19.		
20.		

ELECTRICITY

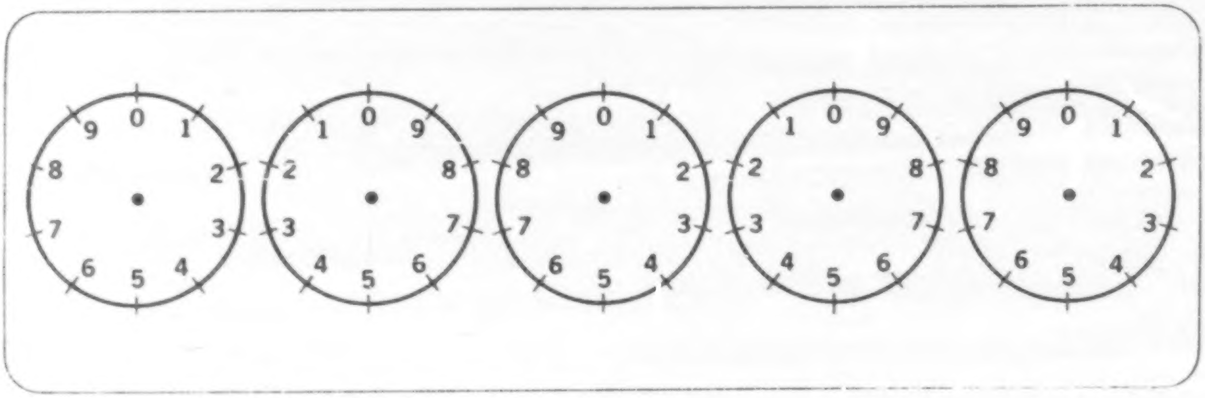
READING THE METER

STUDENT WORKSHEET #2

____
DAY AND TIME


9 0 1 2 3 4 5 6 7 8
1 0 9 8 7 6 5 4 3 2
9 0 1 2 3 4 5 6 7 8
1 0 9 8 7 6 5 4 3 2
9 0 1 2 3 4 5 6 7 8

____
DAY AND TIME


9 0 1 2 3 4 5 6 7 8
1 0 9 8 7 6 5 4 3 2
9 0 1 2 3 4 5 6 7 8
1 0 9 8 7 6 5 4 3 2
9 0 1 2 3 4 5 6 7 8

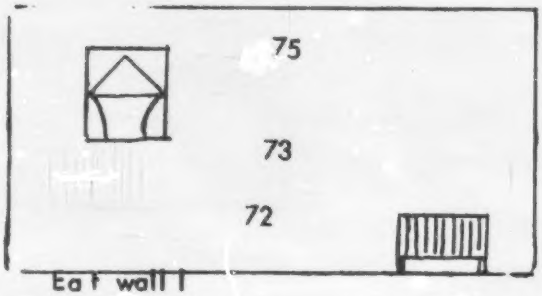
USING ELECTRICITY

STUDENT DATA SHEET #2

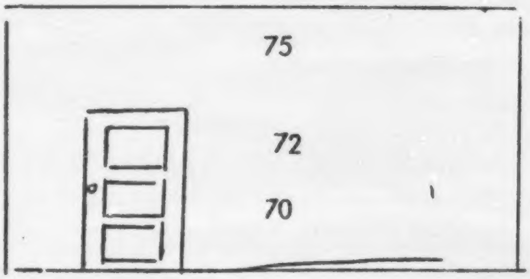
At exactly 5:30 p.m. tonight, go through every room of your home and write down each electrical unit in your house which is in use.

Do the same thing just before you go to bed. Record the time: ______________ p.m.

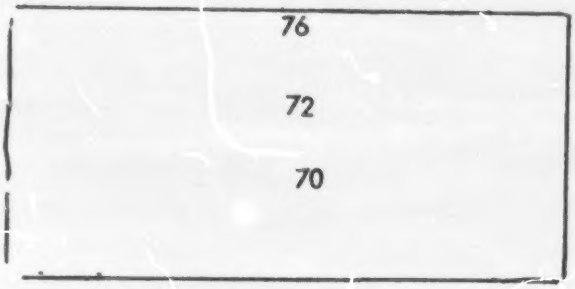
EXAMPLE OF A POSSIBLE MAP WITH REQUIRED RECORDINGS



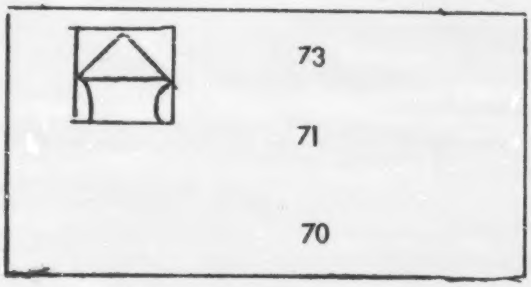
East wall 1



South Wall 2



West wall 3



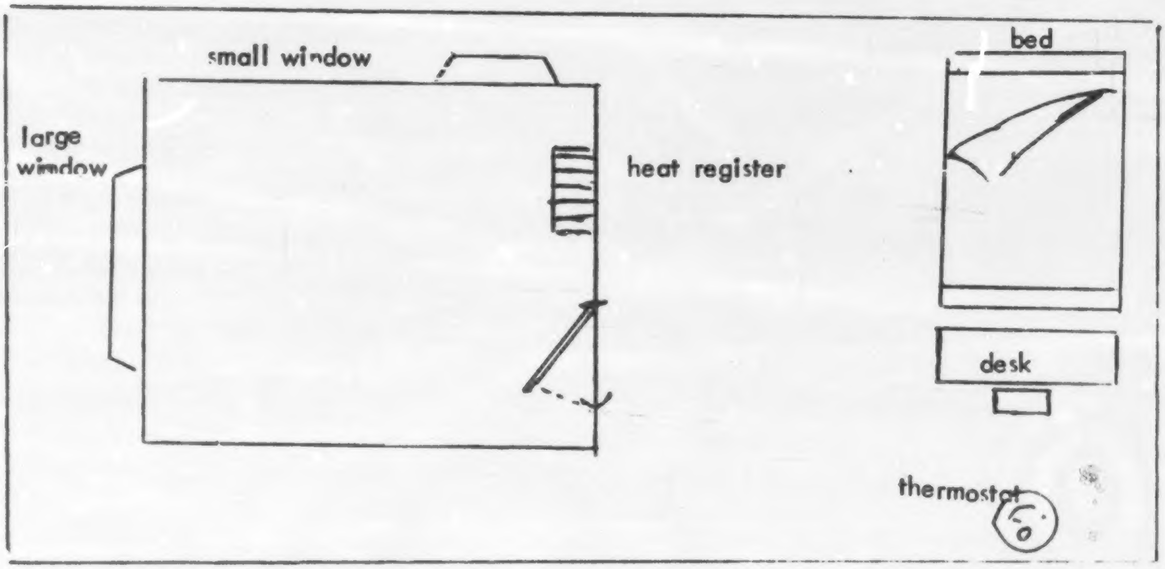
North Wall 4

Extra readings that might be made in this room are;

1 at several spots around the radiator.

2 Around and next to both windows

3 In front of the room.


small window
large window
heat register
bed
desk
thermostat

WALL#1	WALL#@
WALL #3	**WALL #4**

Circle one: Part 1 Part 2

temperature at the center of the room ;

ceiling ---- ____________

Shoulder height ____________

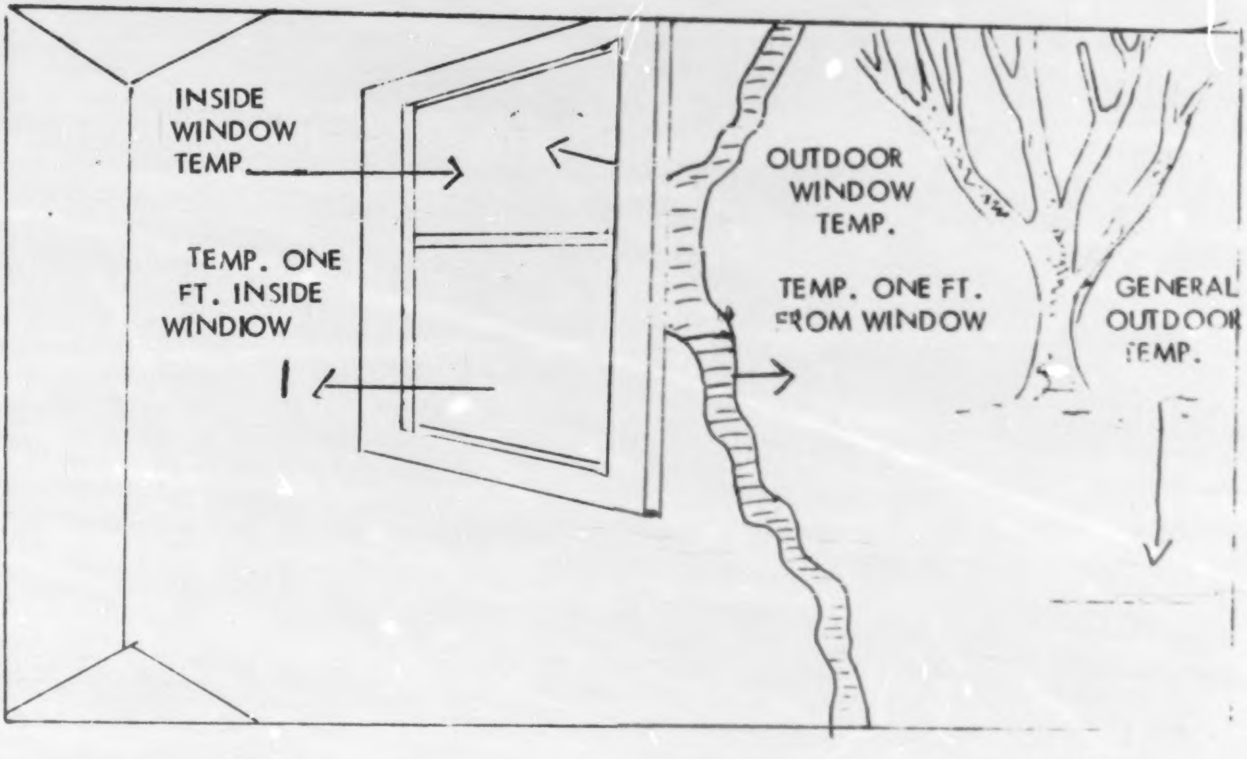
floor ____________

Location and Temperature of other readings :

____________ ____________

____________ ____________

____________ ____________


INSIDE WINDOW TEMP.
TEMP. ONE FT. INSIDE WINDOW
OUTDOOR WINDOW TEMP.
TEMP. ONE FT. FROM WINDOW
GENERAL OUTDOOR TEMP.